Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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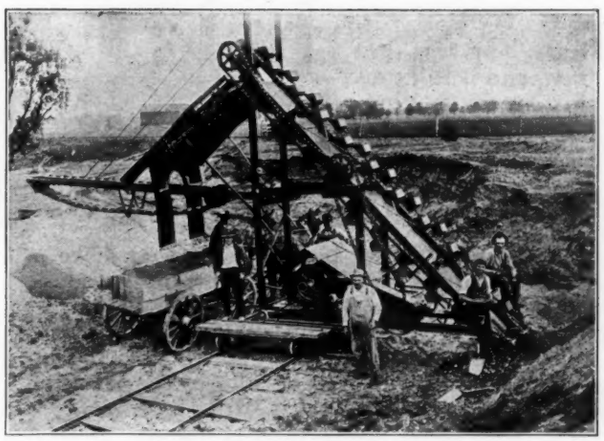

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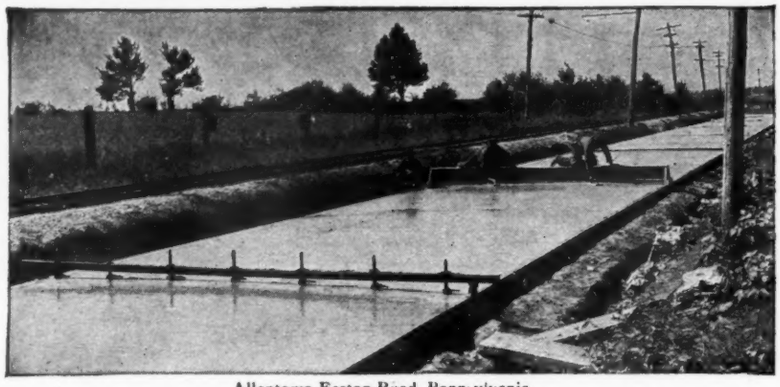

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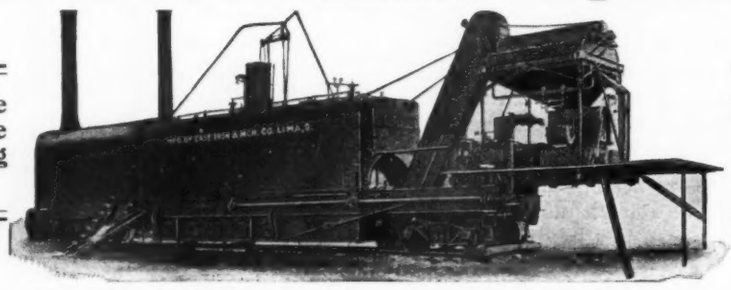

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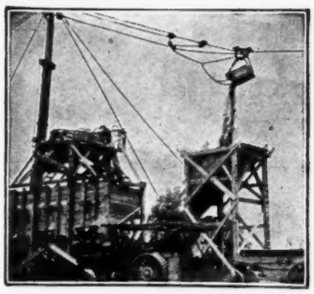

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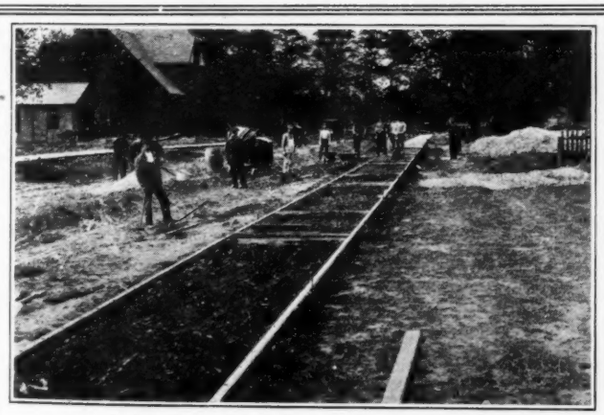

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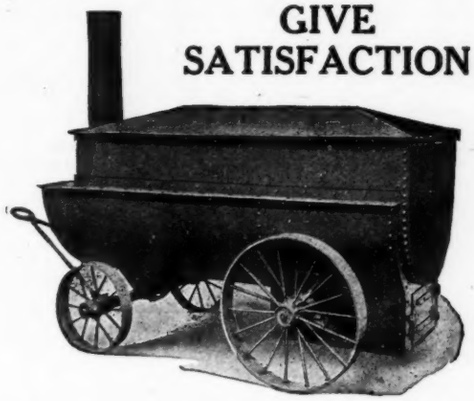

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A Continuous Iron Frame Work—rigid and absolutely true to line. No sagging from dampness.

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MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation

Designed to Carry the Paying Load at the Lowest Possible Cost

The Autocar motor is placed under the seat to shorten the wheelbase and distribute the load evenly over all four wheels.

This equalization of load diminishes wear and tear on tires and truck and allows of lighter construction. And the shorter wheelbase thus achieved gives the Autocar its extraordinary ease of handling.

The Town of Brookline Street Department finds the economy of operation of the Autocar and its ease of handling of great advantage in its work.

Chassis $2050

The system of factory branches established by the Autocar Company assures complete maintenance service.

THE AUTOCAR COMPANY

Ardmore, Pa. **Established 1897**

Autocar

Printed as insert to Municipal and County Engineering, April, 1919.

Mack
TRUCKS

PROGRESS

Progressive Philadelphia is rapidly retiring its slow-moving, horse-drawn refuse carts. MACK Trucks with improved sanitary bodies and power hoists for dumping are modernizing the Quaker City's sanitary service.

Each MACK Truck displaces half a dozen of the old trucks and several men. They make a clean, quick job of removing the city's refuse to the disposal plants at a considerable saving of time, money and labor for upkeep and operation.

MACK Trucks in many municipalities are serving the tax-payers in fire, police and other departments. When you contemplate installing modern motor equipment, write for catalogs and the co-operation of our engineers.

MACK Trucks are furnished in capacities from 1 ton to 7½ tons, with trailers to 15 tons.

INTERNATIONAL MOTOR COMPANY
NEW YORK

"Performance Counts"

Wilson

DEPENDABLE

MOTOR TRUCKS

Meet Every Class of Municipal and County Work

Each Wilson model has its distinct place of usefulness in the Municipal and County Field.

The Wilson 1-tonner is especially suited for runabout haulage of light tools, equipment and men from job to job. This is a very popular model among water works and similar city departments. Just right for maintenance and repair gangs, and for light haulage.

The 2-ton Wilson finds its big field where speed, lightness and good carrying capacity requirements are joined. It is also a popular municipal model and produces excellent results on road work where the going is unusually difficult.

The 3½-ton Wilson is the great favorite among road contractors and local road authorities for the haulage work incident to road construction and repair. This capacity is pronounced the most desirable by the majority of truck users on miscellaneous construction work. Also with special equipment, this Wilson model is much used in municipal work such as sprinkling, flushing, etc.

The 5-ton Wilson is for long hauls and heavy duty work wherever that is required. Trucks of this type are efficient in intercity haulage without destroying the highways. It is also much used by public works contractors in municipalities where the right conditions for heavy trucking are present.

Whatever municipal or county haulage problem presents itself, one of the four Wilson models furnishes the answer.

WRITE FOR FULL PARTICULARS AND PRICES

(*Worm Drive Exclusively*)

One-Ton Two-Ton Three and One-Half Ton Five-Ton

Semi-tractor Trucks of Every Capacity and for Every Purpose

J. C. WILSON COMPANY, Detroit, Mich.

THIRTY-SIXTH YEAR

MOTOR TRUCK OPERATION AND ACCOUNTING XLIV

Truck users in the municipal and county fields are truck boosters. While there is the occasional change from one type or make to another, that is only to be expected, and is found in every other line of business. So it happens that while occasionally a user criticises one make of truck, he invariably praises another, and one does not have to go far to find this user reversed by another. Making proper allowance for personal preferences, no one need be disturbed by these occasional criticisms, especially as they are based in the majority of cases on abuses of the truck by overloading, improper maintenance or incompetent driving. In general, the editor is thoroughly well convinced by his correspondence with truck users that motor trucks are well established and rapidly are becoming well appreciated in the municipal and county fields. Extracts from truck users' letters follow:

What Truck Users Say

M. R. Morgan, clerk of the Lapwai Valley Highway District, at Lapwai, Idaho, gives some information about the performance of their Federal motor truck. He says: "This truck has been used but one season by the district, but has given good service and splendid satisfaction in every way. It has proved cheaper for us to haul surfacing materials with the truck than with teams, as was formerly our custom, although we have no data covering the comparative costs of operating this and other motor trucks. Last season this Federal truck hauled crushed rock up a 7 percent grade and was loaded up to capacity every trip, yet came through with no greater wear than ordinary depreciation under ordinary conditions."

Charles T. Shepard, superintendent of the Department of Public Service, Niagara Falls, N. Y., states that he uses some Federal trucks on his street work and has found them very satisfactory. In ordering two more trucks this season, past performance of the units in the service led to the selection of Federal trucks.

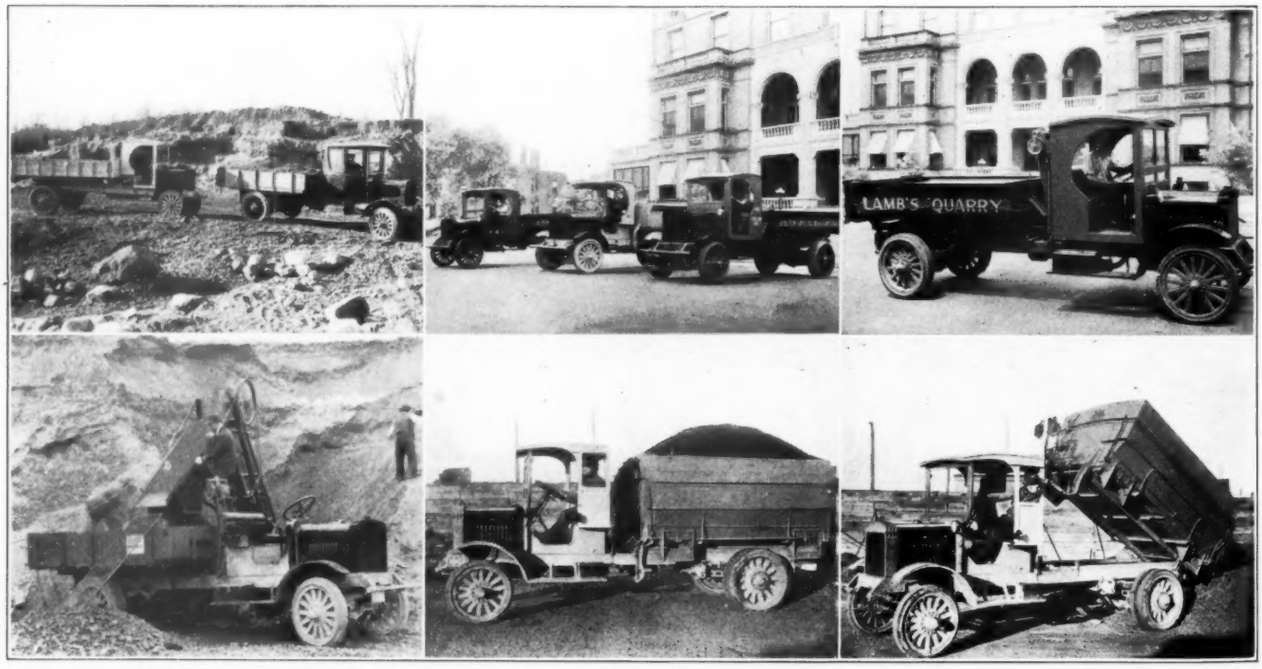
Charles A. French, city engineer, Laconia, N. H., advises that his city bought a Federal truck in August, 1917. This is a 3½-ton unit equipment with a Wood hydraulic hoist. It has been in constant service both winter and summer since it was purchased. Last summer, in building a waterbound macadam road at the Weirs, this truck demonstrated its ability to stand up under hard service. It was used for hauling field stone from stone walls to the city crushing plant, and on the return trips hauled crushed stone to the road under construction. In the city the truck is used to collect ashes and waste, and Mr. French states that it saves much time, as it travels about much more quickly than horses, and after being loaded makes the trip to the dump and back to work in quick time.

D. H. Foster, chairman of the selectmen of the town of Lebanon, N. H., reports having used a Federal truck in their highway department, and advises that it has given good service.

W. F. Kahler, highway superintendent at Winamac, Ind., reports using a 2-ton Federal on county work, and pronounces it a "winner." He states that "any boy can drive it." He unloaded 85 tons in one day from a car and put it on a road, using this truck. Repair expenses have been very low.

George G. Cranbrook, 125 East Grant street, Minneapolis, Minn., advises that he has had excellent satisfaction in using an Acme truck. He writes: "We have been operating one Acme 5-tonner for practically a year, and it has been hauling, over all kinds of roads, gravel and cinders. Our trucks have been on the job every day, and we have found them always able to perform any work which it would be reasonable to ask of any 5-ton truck. We find that in comparing our expenses with those of other large truck users, the Acme is in most cases more economical in upkeep, as well as in cost of operation."

J. F. McGann, who engages in intercity haulage from New-



VIEWS SHOWING SERVICE TRUCKS IN ACTION ON A VARIETY OF MUNICIPAL AND COUNTY JOBS.

Be Guided by Comparison

Compare **Service,** point by point, with any other truck you think of buying. Compare them in power, strength, dependability, economy of operation; and, above all, compare the *proven value.*

Service Motor Trucks are particularly qualified for municipal work. The Superintendent of Public Service for one of our large cities says: "After a very careful comparison of several trucks offered us, we selected the **Service** 3½-ton truck. The truck has given perfect satisfaction and has not cost the city one cent for repairs and upkeep,"

Send for catalog or ask the nearest distributor for full details.

SERVICE MOTOR TRUCK COMPANY, WABASH, INDIANA

NEW YORK
87-89 West End Ave.

Distributors in all Principal Cities

Service
MOTOR TRUCKS

CHICAGO
2617-25 S. Wabash Ave.

Five Models One to Five Tons

ark, N. J., advises that he has operated a number of Acme trucks which have proved satisfactory.

Elsbury Pea, who operates a transfer and storage business at Rushville, Ind., advises that he considers the Acme truck "the best on the market, regardless of price." He is very enthusiastic about his truck, and welcomes opportunities to show it to prospective truck purchasers.

H. L. Worden, city clerk, Cadillac, Mich., reports the use of two Acme trucks in the Cadillac fire department, and advises that they have proved very satisfactory and he recommends this truck for any kind of service.

R. T. Coughtry, town of New Scotland, Voorheesville, N. Y., reports the recent purchase of an Acme truck, and states his belief that the unit is a great labor saver and a good investment for the town.

A. G. Merydith, of the C. W. Merydith Contracting Company, Eldorado, Kans., advises that his company has never operated a truck, nor have they examined a truck, capable of handling material under the same difficult road conditions as the Duplex.

Scott Bros., general teamsters and contractors, 1529 South Front street, Philadelphia, report operating a Duplex truck for about ten months. The truck has been used chiefly for trailing heavy engines, boilers, pile-drivers, etc. As Scott Bros. are one of the largest teaming concerns in Philadelphia, they do much of the heavy hauling for the construction contractors and for the government. They used their Duplex truck not only in the city, but occasionally for making trips between towns, trailing mixers, engines, etc., but they do not encourage such hauling on account of road conditions. On these intercity trips, especially on roads where there are bad hills, Scott Bros. have found the extra transmission on the Duplex very useful, as well as when operating in soft ground.

For general all-around work Scott Bros. are partial to the 3½-ton Garford truck and pronounce it the most reliable and economical truck on the street. They have three Garfords in service and have seen them go through with work that some other trucks failed to negotiate.

A. M. Hare, county judge, Tillamook County, Oregon, reports good service from the Duplex truck they have operated for little more than a year.

Vernon J. Brown, county clerk, Ingham County, Mason, Mich., calls attention to the following paragraph from the latest annual report of the Ingham County Road Commissioners:

"Last year, when help began to get scarce, we bought two Duplex trucks for the purpose of drawing gravel. Since that time help has continued to grow more scarce, and in order that we might get the work done, we have purchased four Duplex trucks, one Ford truck and are hiring a Menominee truck. The total cost of the maintenance, gasoline and oil for the six trucks since Jan. 1 has been $4,161.56. The insurance amounts to $402 and the depreciation, figured at 20 percent on four trucks, amounts to about $3,000, making a total of $7,536.56. The cost of drivers amounts to $2,583.18, making a total cost of running and maintaining six Duplex trucks approximately $10,146.75. These trucks worked a total of 689 days, drawing gravel 589 days, thus costing approximately $14.75 per day. The total number of miles covered were 38,859, at a cost of approximately 28c per mile. The number of yards of gravel drawn were 9,860, at a cost of about 88c per yard. These Duplex trucks worked about 100 days at drawing tools, material and doing plowing, etc., besides the 589 days drawing gravel. The average round trip on the gravel haul is about 8 miles."

Late in March Mr. Brown reported the overhauling of the four Duplex trucks for the summer's campaign. The cost of this work was higher than it should have been, but the road commissioners do not consider this a reflection upon the truck, but upon the class of drivers and repair men that it has been possible to secure of late. Mr. Brown considers the Duplex a powerful machine, particularly adapted to hauling where the soil is loose, which makes it desirable for gravel hauls. He states that practically every worn or broken part found in the recent overhauling of this Duplex fleet indicated that the main trouble was with too rapid driving or too little attention to lubrication.

In what precedes, names of trucks have been frankly given. Letters of the same character might be quoted about other well-known trucks. The idea is not at all to give testimonials for this or that make of truck, but to show how, in following down lists of truck users, the praise for the particular truck the correspondent operates is almost unanimous, and each user is, as a rule, confident that *his* truck is the best on the market. This shows that trucks are immensely satisfactory to their users in this field and that is the purpose of this review.

Kissel Trucks on Mountain Road Construction

A good example of how motor trucks will make good in

RIKER 3-TON SPRINKLER TRUCK AS OPERATED BY MENDOCINO COUNTY, CALIF.
This Truck is Equipped with a Tank with Sprinkling Heads and a Suction Pump and Hose for Filling the Tank from the Many Streams the Road Crosses. In this Way it Becomes an Easy Matter to Sprinkle Long Stretches of Country Road.

The Truck that Helps the Dealer

THE Schacht is a truck that helps to sell itself. It is massive and substantial in appearance—it makes the best kind of an impression on the buyer, and the more he knows about trucks the better he likes the Schacht.

In service it has made a record as convincing as its appearance is attractive. Contractors find that it stands up to the roughest of rough work and delivers transportation at the lowest ton mile cost. Repair expense is always light.

For eleven years Schacht trucks have given good service. For seven years they have been worm drive trucks unchanged in any essential. Scores of firms who have bought one Schacht truck have later bought them again and again.

Here is a really profitable line for the dealer in contractor's equipment. Write for the facts, or better yet stop at Cincinnati and go through the factory.

CAPACITIES: 2, 2½, 3½ and 5 ton.

The G. A. Schacht Motor Truck Company
CINCINNATI, OHIO

Schacht WORM DRIVE Motor Trucks

work under difficulties is illustrated in a letter recently from a prominent engineering company that has just finished a difficult piece of road building in the mountains of West Virginia.

This engineering company has been employing a fleet of ten Kissel freighter trucks in "work that has been on heavy grades and narrow roads, hauling materials to concrete mixers, where the trucks have to make turning places every 500 ft., necessitating every load being turned at the turning place, on heavy grades, and then reversed and backed for the full 500 ft., usually on a 9 per cent grade—work that tests the power and durability of the trucks to the utmost.

"On this particular piece of road building a good part of it is literally built along the side of a mountain, and to show how hazardous the work is at times, one of our trucks went over the mountain side, falling a distance of about 300 ft., making several complete turns before landing at the bottom, when it struck a frame house and tore the kitchen away entirely from the other portions of the house."

The engineering company added in their report of the incident: "By reason of the truck's rigid construction, the only damage done was to the radiator and seat. These repairs were made and the truck went back to work."

"Again, we had another truck fall over the mountain side near Welch, W. Va., with a load of stone on it, making several complete turns, and left hanging on a tree. The driver was picked up unconscious and taken to a hospital, the truck reclaimed by the use of block and tackle, the cab seat and radiator repaired, and put back to work.

"Still another truck upset over a mountain side, injuring nine men, and was pulled back, righted and brought home under its own power. These accidents did not in any way twist or damage the axles and in no way affected the smooth running of the trucks since the accidents.

"Every taxpayer or person who has taken any interest in the work on the 20 miles of roads that we have built here, is unanimous in his praise of Kissel trucks, and as the truck end of a job like this is a large percentage of the whole, we recommend that in any road building taken up in any community, taxpayers as well as road contractors should use their best judgment in the matter of selecting the motor trucks to be used on the job."

Using Trailers to Obviate Unloading and Loading Delays

Three trailers and a short wheelbase Pierce-Arrow truck have cut a big haulage expense in the case of the Hood Rubber Company, of Watertown, Mass. The firm uses the equipment on work that required long loading and unloading periods. Four standard 5-ton Pierce-Arrow trucks are used for the company's normal haulage work.

The tractor and trailers are used to haul thousands of small boxes of rubbers, canvas shoes and such merchandise from the factory to a warehouse at Brighton, three miles distant. Formerly a truck could make only four trips a day, because of loading and unloading delays. Loads were limited to 4 tons because of bulk.

But with the trailers, eight trips a day are accomplished. Instead of 16 tons of goods, 48 tons are carried, with but slight additional operating costs. While one trailer is being hauled, another is at the warehouse being unloaded and a third at the factory being loaded. It requires but two or three minutes to shift from one trailer to another.

"Haulage tasks which involve loading and unloading delays frequently can be handled to advantage by the use of trailers, as can be seen by this striking example," said the local Pierce-Arrow dealer. "Short wheelbase Pierce-Arrow trucks are admirably adapted to this work, because of their inherent speed, economy and durability."

Attitude of Public Toward "Good Roads" Undergoes a Radical Change.

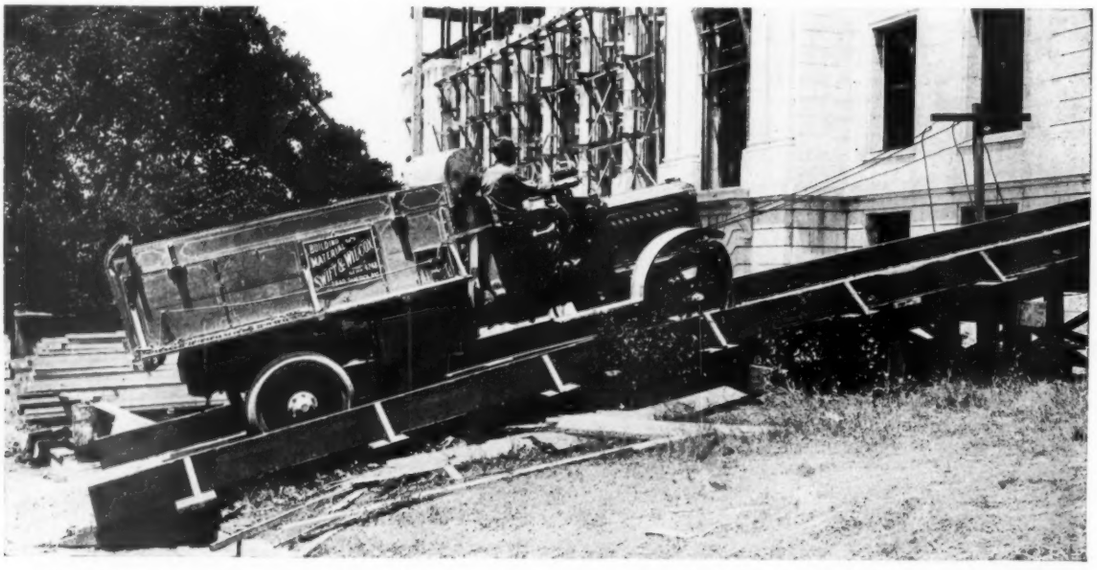
By E. A. Williams, Jr., President of the Garford Motor Truck Company

The public's conception of "good roads" has undergone a radical change in the last two years.

Prior to the entry of the United States into the world war, the non-motoring American public, more often than not, thought good roads were advocated chiefly for the benefit of their more fortunate neighbors who owned and drove their own motor cars. They were inclined to regard good roads laws as class legislation, and were unwilling for the most part to lend either financial or moral support to the construction and upkeep of something from which they derived no direct benefits so far as they could see.

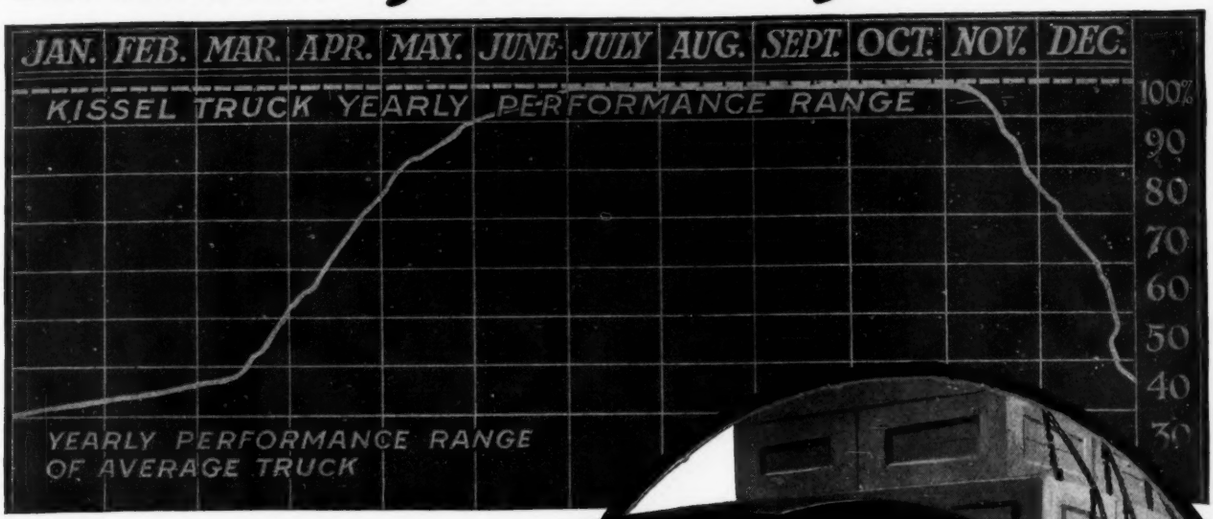
That conception no longer exists. Universal recognition of the motor truck's value as a means of transportation, demonstrated under the stress of war, has brought about a change.

The war merely hastened what leaders of the industry had foreseen for several years; it furnished the setting and the conditions which enabled the truck to establish itself as a fac-



RIKER 5-TON TRUCK AS OPERATED BY SWIFT & WILCOX, BERKELEY, CAL., HAULING BUILDING MATERIALS UP AN APPROXIMATELY 26 PER CENT GRADE.

Uninterrupted Transportation



KISSEL TRUCKS

THE far reaching effect of Kissel's eleven years of motor truck designing and construction experience is found in the 365-day-a-year-Kissel-truck service-range—trucks that maintain 24 hour schedules each day througout the year because they are built to overcome obstacles unsurmountable with trucks of less development.

This 100% service range is possible only with a perfectly balanced truck—in which weight, size, dimension and power are related to one another in exact proportions—giving an incomparable chassis of perfectly balanced moving and fixed units, headlined by the powerful Kissel-built engine and topped with the ALL-YEAR Cab, that keeps motor trucks in operation throughout the winter by giving full protection to truck drivers.

Never before has the necessity for uninterrupted transportation become such a national business necessity as today. The unusual days ahead make it imperative for every business man—every manufacturing and industrial executive—to equip his transportation department with motor trucks that will prove equal to their production output.

Uninterrupted Transportation can be secured through Kissel dealers in any of the principle cities where specifications and the 1919 Truck Catalogue may be had, or direct from the factory.

Kissel Motor Car Co., Hartford, Wis., U.S.A.

tor in the economic life of the country. Under normal conditions its recognition and general adoption would have been more gradual, but none the less convincing.

The non-motoring public no longer looks upon good roads as "speedways" for the motoring "aristocracy." It has come to realize that motor trucks are essential as transportation factors and that good roads are necessary to the efficient operation of trucks. Its vision has been broadened; it sees the advantages and benefits which accrue from a combination of these factors—benefits which have a direct bearing upon the economic conditions of the community.

It sees the farm brought, one might say, to the very table of the consumer; it sees an ultimate decrease in food prices; and those who pause to consider the matter further, see the ever-expanding range of possibilities of the truck and its ally, good roads, throughout the industrial and commercial world.

With the universal recognition and adoption of the motor truck, the public's conception of how roads should be built also has undergone a change. Heretofore there has been a vast difference between the average man's idea of good roads and that of the experienced engineer. The average man was content to build for the present; the engineer, as the result of past and not altogether satisfactory experience, knows and has known the importance of building for the future as well as the present.

The first thing a railroad does after obtaining a right-of-way, as every one knows, is to build a roadbed and lay tracks. That roadbed is put in to stay. The track, which corresponds to the surface of the highway, is built of the most substantial and practical material to be had.

The railroad officials, however, do not expect this roadbed and track to last forever without attention. Long ago they learned that the only way to assure safety and durability is to anticipate depreciation and make constant repairs.

For this purpose they maintain crews who are continually repairing and reconstructing the roadbeds and replacing tracks. From time to time flaws are certain to develop—conditions and elements over which man has no control are responsible. These are quickly remedied—reinforced—by the crews, which always are on the lookout for such breaks.

That is just what we are coming to in road-building. For years it has been customary for county engineers to direct such operations, but for the most part their work has been hampered by lack of funds and inadequate force, or by limited legislation and more or less red tape. There are some states in which farmers are still working out their road tax by the day, hauling gravel or stone in a more or less haphazard fashion for the construction of roads; upon their efforts and those of a limited force of hired workers depends the maintenance of the community's highways.

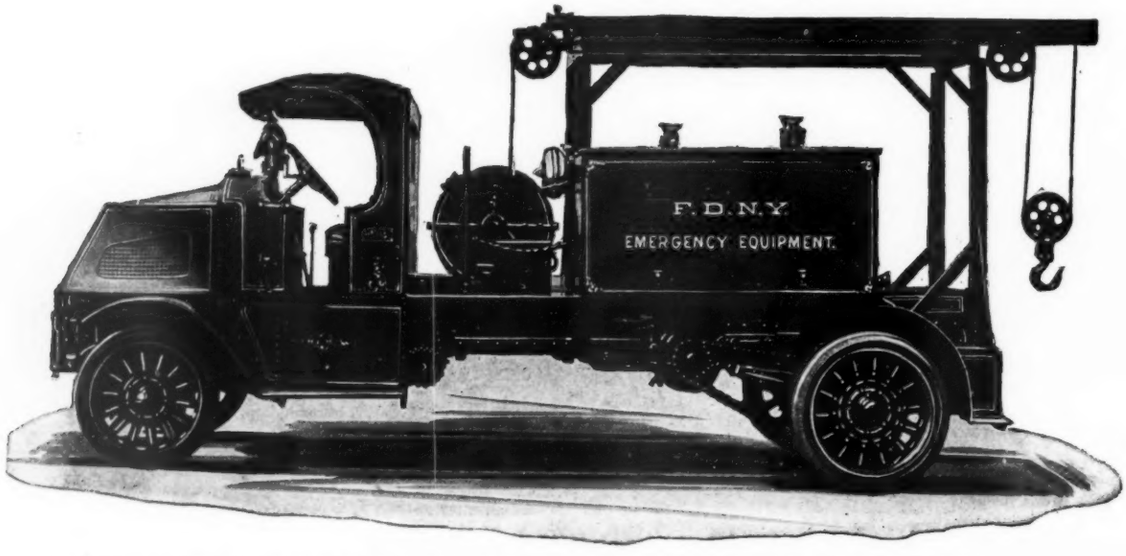
In the past we have built for the present only; in the future we will build for the present and future. We have come to realize the economy of constructing roads of lasting materials, of laying the most durable foundations—foundations which will last for time upon end and require a minimum amount of attention.

Our forefathers recognized, in a manner, the necessity of installing durable foundations back in the days when they built corduroy roads through the wilderness of this country. Recently, in an Indiana city, engineers were installing a concrete foundation along the main thoroughfare. In excavating they came upon a corduroy road, buried several inches under the street surface. The road was constructed of black walnut, and extended, they found later, for a distance of nearly a mile. Rather expensive roadbeds in these days. The logs were in excellent condition. They made a complete new survey and utilized the old roadbed in their concrete construction.

Roads of the future will not be built to meet the requirements which necessarily will be made upon them, but they will be maintained, or should be, in the same systematic manner that a railroad maintains its property. As the railroads utilize their own equipment for repairing and construction purposes, the truck will be utilized in good roads building and upkeep. Road maintenance crews, with their truck equipment, will be as familiar a sight as we see constantly at work along railroad right-of-ways.

Highway improvement naturally is in its infancy. It will be many years perhaps before the vast system which will extend throughout the country will become a reality. But with the impetus gained during and immediately following the war the work should progress with greater rapidity and more discernible results in the next five years than it has in the past score of years. Congress has shown its appreciation of the vital need for improved highways by passing an amendment to the Postoffice bill providing for an increased appropriation of $200,000,000 to be expended in highway development.

State legislatures throughout the country are and have been engaged in the consideration and passage of numerous bills which carry large appropriations for the development of roads. Even this is just beginning.



MACK 5½-TON EMERGENCY TRUCK USED BY NEW YORK CITY FIRE DEPARTMENT.

"Return loads will cut your haulage costs"

FEDERAL FIRE TRUCK OWNED BY THE CITY OF CHICKASAW, ALABAMA

Federals Save the Public Funds in the Long Run

Whatever else a community may neglect, it seldom forgets its fire department now-a-days. A majority of even the smaller cities all over the country are provided with the only safe and sure protection—motor fire trucks.

Midnight fires, fanned to raging flames by a gale, have driven home to many a town the decided wisdom of motor apparatus, and in a surprising number of cases their choice has been the Federal.

In a less spectacular way, the Federal truck is steadily winning recognition in other departments of municipal work—where its saving in time and public expenses are resulting in its constantly increasing use.

"Traffic News," a magazine of haulage facts, will be sent to any municipal officials or interested citizens upon request.

FEDERAL MOTOR TRUCK CO.
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One to Five Tons Capacities

Don't let your

THERE is big work to be done. New markets wait for those who can deliver the goods. Keep your factory wheels turning and your goods moving. The future belongs to those who act quickly. Pierce-Arrow trucks kept many a factory running bringing raw materials and carrying finished products to market without delays.

Pierce-Arrow trucks are available now to do their part. Our experience is at the

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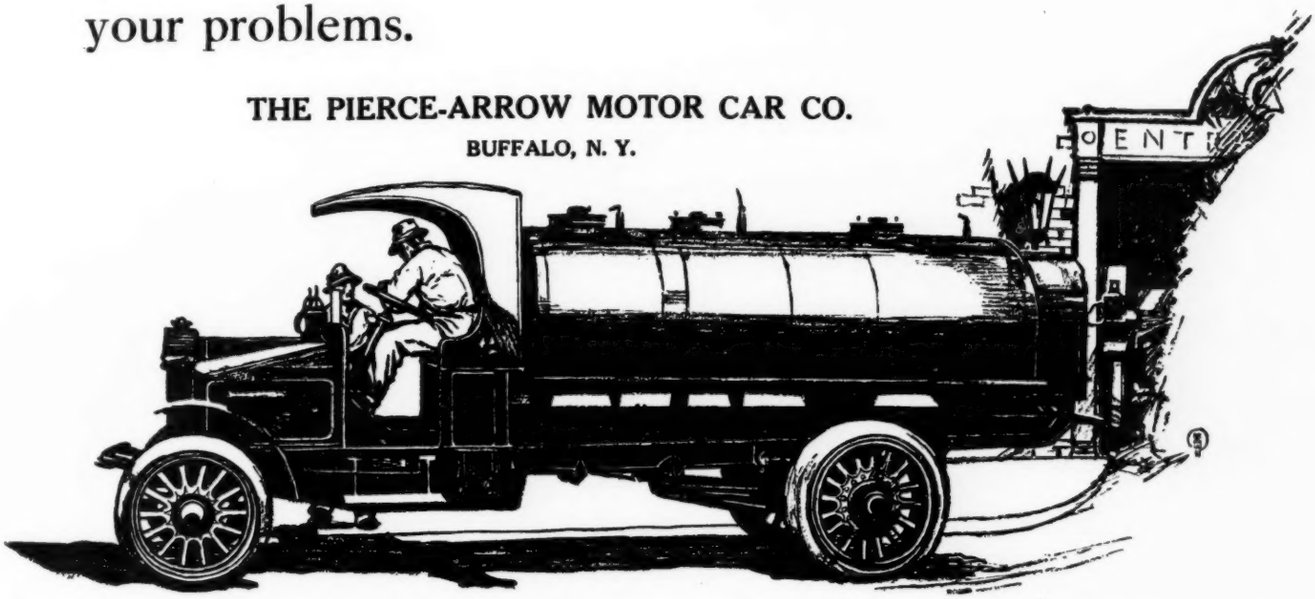
wheels slow up

disposal of those who need aid in expanding or redirecting their transportation facilities. We know what to do and how to do it cheaply and quickly.

We have met successfully all conditions of service in 148 different lines of business, including yours. Ask our assistance on your problems.

THE PIERCE-ARROW MOTOR CAR CO.
BUFFALO, N. Y.



Delivers more work in a given time;
Loses less time on the job and off the job;
Costs less to operate and less to maintain;
Lasts longer, depreciates less and commands a higher resale price at all times.

What Jones found out about his motor trucks

How a real study of the motor truck problem made surprising savings possible

WHEN Jones bought his first truck he was convinced he had purchased the best truck on the market. But a few months later he wasn't so sure. The next time he bought a truck it was a different make. But the new truck seemed to give no better satisfaction than the first and so far as Jones could make out the repair bills weren't anything to have pleasant dreams about.

Naturally he blamed the truck.

"My trucks are costing me a pretty penny," he remarked one day to his friend Wilson, who had dropped into his office.

"Why that's funny," said the friend who happened to be in a business that used trucks extensively. "We are using both

those kinds of trucks and they are giving us splendid satisfaction. Exactly what is your trouble?"

"For one thing," replied Jones, "I've had a lot of trouble with my drivers—delays and the like, and they don't seem to give a rap how they handle the trucks. Then a lot of time is wasted loading and unloading and ....."

"Do you know exactly what your trucks are costing you?" interrupted the friend.

"Approximately, yes; accurately, no."

"Just what I thought—you need a cost system that will show you exactly what it is costing to run your trucks per day and per mile. And you need a lot of advice about other truck problems as well."

"But how am I to get it?"

The friend told him how he could study the motor truck problem and solve the difficulties.

Three months later when the two met, Jones had an entirely different story to tell.

"Say, old man," he said, "that tip you gave me about motor trucks has worked wonders. I have cut my repair bills fifty percent, increased the actual running time 28 percent. And I have only begun to accomplish things. I am not going to stop until my trucks are 100 percent efficient. But honestly, I never thought how much one can learn about motor trucks until I really got down to studying them."

* * *

The Jones story is typical of what hundreds of actual motor truck users have accomplished after devoting part of their time to a real study of the problems involved in the operation and maintenance of motor trucks.

Helping Hundreds

Unfortunately, as in the Jones story, many blame the truck when it fails to perform as the truck salesman said it would. There are many good trucks on the market and the manufacturer does his best to make his truck of real service. But the best truck a man may buy will not give the satisfaction the manufacturer has designed it to give if he treats it as some big, rough powerful thing that can be abused as much as he likes. The man who uses trucks can increase their efficiency, and save himself many hundreds of dollars, both in their operation and maintenance, and can speed up their work, if he will carefully study Mr. S. V. Norton's new book—**The Motor Truck as an Aid to Business Profits.** A pioneer in this important field, Mr. Norton has, out of his wide experience and intensive investigation, produced a veritable encyclopedia of motor truck facts and figures, and on almost every one of the 530 pages of this comprehensive work may be found some money saving plan, or suggested device that you can perhaps at once apply to your very business, and so increase the life of your truck. "We regard **The Motor Truck as an Aid to Business Profits** as containing the largest amount of practicable information upon this subject that is available in the country, writes W. A. Alsdorf, Secretary of the Ohio Good Roads Federation, Columbus, Ohio. The suggestions contained in it will save many dollars a year to the truck owner. As a business proposition he cannot afford to do without it." Scores of manufacturers, truck owners, and business men everywhere have given their endorsements to this valuable work. An idea of the value that the contents of this book will be to you may be gained from the following list of "hows."

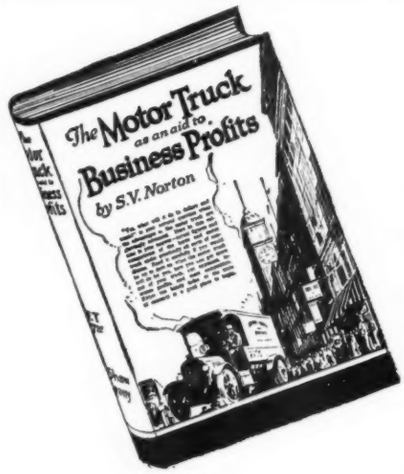
Consider the Value of one of These "Hows" to You

—How to determine what truck is the best for you to buy.
—How to keep accurate costs.
—How to stop delays.
—How a Chicago concern saved $8,700 in one year's operation.
—How an Ohio contractor reduced the loading time of his truck.
—How to plan your routing to save time.
—How to increase the load carried per trip.
—How trailers save one third on hauling costs, what features to look for when buying a trailer.
—How to speed up unloading.
—How to get your drivers' cooperation.
—Seven rules that save accidents.
—How to install a time recording device that will increase the running time of your trucks.
—How to install a bonus system for drivers.
—How to cut maintenance costs.

—How Captain B. B. Lipsner solved the problem of operating and maintaining a fleet of 600 trucks scattered over a territory of 35 states.
—How to save money through proper lubrication.
—How to stop leaks in the supply room.
—How one chief construction engineer used his trucks to get more business.
—How an Eastern paving contractor delivered asphalt at an increased saving of time and money—and increased the radius of his operations.
—How a loading device enabled one contractor to take in $83.63 in one day with one 5 ton truck.
—How a motor truck association protects the truck owner.
—How to meet anti-legislation.

No Money Down

The best proof of all is to judge for yourself from the book itself. Send no money. You can examine the book free for ten days. If, at the end of that time, you find the book is a real help to you, and you decide to keep it, send us $7.80 in full payment. If, however, you feel it will not help you, or if, for any reason at all, you do not wish to keep it, return it at our expense, and it won't cost you a penny. In replying please mention Municipal and County Engineering.



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112 charts and blueprints

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I wish to examine free for ten days Mr. Norton's book, The Motor Truck as an Aid to Business Profits. If I wish to keep the book I will send you $7.80 in full payment. If at the end of the time I do not wish to keep it I will return it to you at your expense. M. E. 419

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ACME THE TRUCK OF PROVED UNITS

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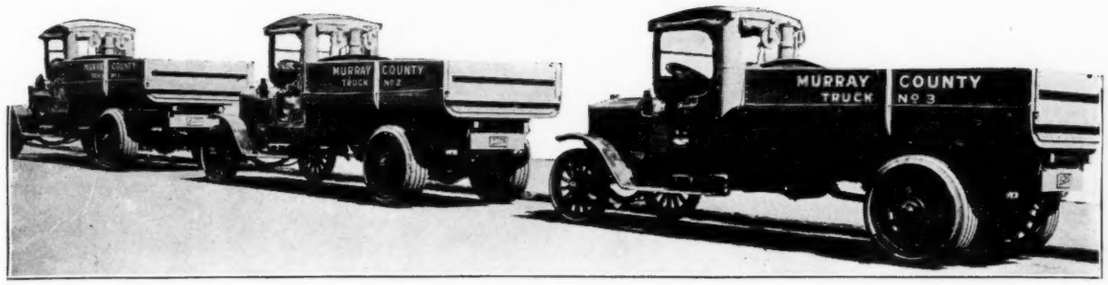

Fleet of **Acme Trucks,** equipped with special hydraulic gravel dump bodies, being used in Murray County, Minnesota. Write for *"Pointers to Profits,"* which tells why the **Acme,** the truck of proved units, is the accepted truck for municipal and county work.

ACME MOTOR TRUCK COMPANY, 427 Mitchell St., **Cadillac, Mich.**

ACME PROVED UNITS
Continental Red Seal Motor
Timken Axles and Bearings
Timken-Detroit Worm Drive
Cotta Transmission
Borg & Beck Clutch
Eisemann High Tension Magneto
Rayfield Carburetor
Centrifugal Type Governor
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The Truck of Proved Units

In the **Acme** truck only such units of construction are used which have been endorsed by the engineering experts of the automotive industry.

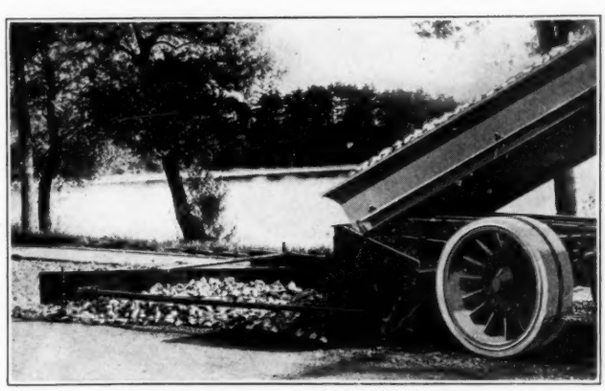
These units, known as **"Acme Proved Units,"** were brought together without consideration of cost and built into the **Acme.** You can count on **Acme** Performance in advance because of these standardized units.

Better Stone Spreading at Reduced Cost

Results from the Use of the Burch Stone Spreader

The **Burch Stone Spreader** and Distributor entirely eliminates the rehauling and shoveling of stone, as the stone is placed where it belongs in the first place. Of course this practically eliminates labor costs and labor troubles.

The operation of the **Burch Stone Spreader** is precise and eliminates all guesswork. Attached to any motor truck this spreader eliminates waste of stone by keeping the thickness at just the specified depth at all points. This conservation of stone soon pays for the spreader. One contractor saved enough stone on two miles of road to pay for his spreader. Of course he also saved on labor and was that much ahead. The work was entirely to the satisfaction of the engineer.



Burch Stone Spreader in Operation.

The thickness of stone is regulated by raising or lowering the gate of the spreader. By the use of the wing attachment shown in the illustration, the stone can be spread the entire width of the pike at the specified depth. Wings are adjusted for width of spread and also for depth of stone. A crown to the road can be given by raising wings higher in center than at ends.

Road builders who operate motor trucks should also take advantage of the material and money saving effected by these **Burch Stone Spreaders.**

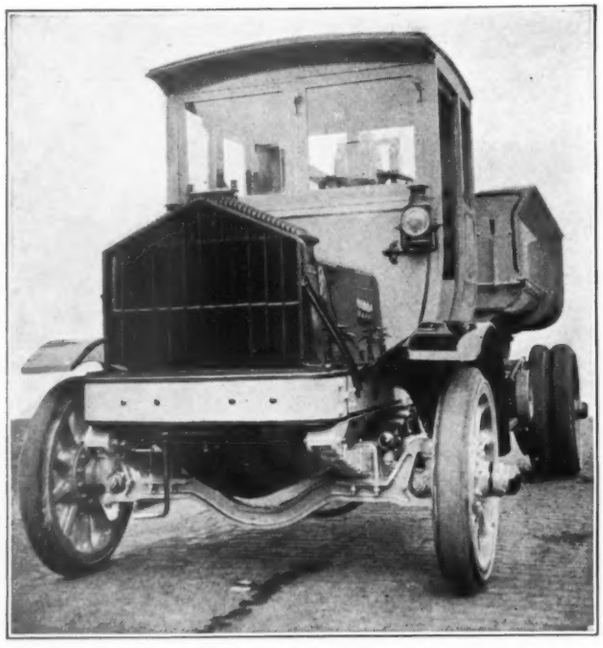
Write today for prices and full particulars to

THE BURCH PLOW WORKS CO., Department A **Crestline, Ohio.**

Here is the Highway Locomotive

Equipped for Day or Night Driving Over All Kinds of Roads, in Any Kind of Weather

This HALL Truck Leaves Nothing to be Desired



The Hall Truck here illustrated is the standard 5 to 7-ton dump unit equipped with the new Hall All-Weather Cab. This cab promotes the efficiency of the driver by protecting his health and insuring his comfort. Units of this type are meeting a ready sale among contractors and road builders.

This cab is not only weather proof—it is also rattle proof. The openings at the sides are closed at will by curtains of the street car type that run up easily to the top of the cab. The windshield is of touring car grade. In cold weather heat is admitted at will to the cab interior from a duct passing under the hood. Thus the driver can absolutely control the ventilation and temperature in the cab at any season of the year.

Hall trucks are widely used on public works construction and maintenance. From coast to coast the **Hall** is giving satisfaction *plus* to contractors and public officials.

Names of numerous users of **Hall** trucks among contractors and in the municipal, county and township fields furnished on request.

"HAUL IT IN A HALL"

You don't need to experiment! Buy a truck that has made good!

THE LEWIS-HALL IRON WORKS

Manufacturers of the HALL Truck

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EDITORIALS

Better Days Coming for Engineers

Of very great interest to every engineer is the progress being made toward improving the working conditions and salaries of professional engineers employed by the railroads. The railroads have always been the largest employers of engineers, and have, in large measure, set the scale of compensation for every engineer in America. That this scale was always too low and that it has been especially unfair in recent years are notorious facts. So great is the present prospect of improvement that every engineer has cause to anticipate an early and favorable readjustment of his affairs if he will but be alert and co-operate with others in working for better conditions.

A schedule of salaries for railroad professional engineers was adopted by the National Conference of Railroad Engineers held in Chicago on March 17, 1919, under the auspices of the American Association of Engineers. Following this conference there was a hearing on the pay of professional engineers before the Board of Wages and Working Conditions, U. S. Railroad Administration, March 31-April 2, in Washington. That the board will make recommendations for substantial increases in the subordinate positions there can be no reasonable doubt, but when this will be done is not certain. The principal difficulty before the board is to define the duties and responsibilities of the many positions and to establish a dollar-and-cent ratio. The board was easily impressed with the glaring injustice under which engineers have so long labored and appeared anxious to right old wrongs. From the magnitude of the task of standardizing positions and duties and fixing compensation for the various positions, it appears that two or three months may easily pass before the board will have reached a satisfactory solution of the various problems involved in the readjustment. It is interesting to note that in its memorandum to the board the American Association of Engineers not only asked that a speedy decision be reached, but that the new schedule of wages be made retroactive. Thus to our railway brethren both retrospect and prospect are alluring. There is ample precedent for making retroactive any wage increases granted the railroad engineer.

The American Association of Engineers presented at the hearing before the board the resolutions and schedule of salaries adopted at the Chicago Conference. The clause against overtime, "no pay for overtime," was the subject of a good deal of questioning on the part of the several members of the board, but the testimony of all witnesses, whether called by the A. A. E. or not, was against overtime for engineers.

The Engineering Council, an organization of national technical societies, representing some 40,000 members, recognizing that the A. A. E. represents the engineers in the junior positions in railroad service more thoroughly than does the Council, and by reason of the Chicago Conference on March 17, turned over the presentation of the case to the A. A. E. and backed it up unselfishly. There was no evidence of anything but a united front and harmonious support at the hearing. There were differences of opinion between the representatives of the Engineering Council and the A. A. E., but these were composed before the hearing. Thus it appears that engineers are now able to rise above petty rivalries and jealousies to reap the benefits of co-operation and compromise.

The hearing before the board, considered in connection with the Chicago Conference, has already demonstrated the value of a business organization of engineers such as the American Association of Engineers. Many doubters have been convinced, and are now spreading the gospel of co-operation among engineers.

It is highly important that engineers continue watchful and build up the A. A. E. so as to help "through the narrows" the recommendation for salary increases that the board will surely make.

It is again urged that all engineers support the A. A. E. by joining it. While the railroad engineer is now having his inning, the public engineer is next in line, and should insure his own future welfare by acting now on this advice to join the A. A. E.

The A. A. E. has won a great victory. The association is only four years old, yet, we call on the profession to witness, when an opportunity came to advance the entire group of railroad professional engineers the A. A. E. seized it and acted upon it. It is true that the Engineering Council co-operated in the movement and is entitled to much praise for their ungrudging support. "Old men for counsel, young men for war"—and so it was in this case. The old national societies—the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Institute for Testing Materials—compose the Engineering Council and supplied the counsel in this case. That sturdy young warrior, the American Association of Engineers, was there to do the fighting, but was so fit for a fight that no fight developed, which seems to bear out the arguments of the preparedness advocates. The A. A. E. will be long remembered for this achievement. There is credit enough for all, but the unprejudiced onlooker will award most of it to the A. A. E. and he will not forget that it was the A. A. E. that not only accomplished things itself, but galvanized the older societies into activity.

At the hearing before the Board of Wages and Working Conditions of the U. S. Railroad Administration, the board inferentially raised the question: "Why have you waited so long, you engineers, before seeking relief?" We do not know how the question was answered, but the true answer is interesting and illuminating. There were many reasons why engineers waited so long. One reason was that they spent several decades in commiseration, in telling each other how badly they felt at being so little appreciated. With the discovery that this curvilinear motion was not getting them any place, they gradually started to take the public into their confidence, and in recent years a certain influential section of the general public has come to understand that professional engineers gave much and received little. With the formation and development of the American Association of En-

gineers there developed within the profession the will to advance and co-operate. Engineers are now learning to co-operate and the magnificent profession of engineering is in a fair way to receive just compensation for its services and full recognition from employers of engineers and from the great body of our fellow-citizens who make up the general public.

Engineering was always a noble calling; in growing more profitable it need lose none of its nobility.

A Modern County Engineering Problem

The utilization of the principle of the hydraulic jump or standing wave to destroy the energy of 2,000 cu. ft. of water per second precipitated over a bluff 110 ft. high, as described in this issue, serves well to illustrate the importance of county engineering work today, for this was a county problem. Those who are still thinking of county engineering work as little more than land surveying, plus road dragging and grading, will do well to note the complex nature of the specific county engineering problem under discussion, its skillful solution and the nature and extent of the requisite engineering structures.

The problem presented was of such character that its solution was handled by a prominent consulting hydraulic engineer, who was called in by the Board of County Commissioners. The spillway structure illustrated and described is so unusual that it is of exceeding interest to hydraulic engineers. How the energy of the water was absorbed without destructive effects is fully explained. The works selected comprise a paved open channel, sluiceways, a shaft and tunnel, open flume, deflector beam, and a concrete stilling basin. Where the secondary expansion takes place below the primary stilling basin the water was allowed to excavate its own secondary stilling basin. The manner of accomplishing this hydraulic excavation was most ingenious. The article will interest county and state engineers as well as consulting hydraulic engineers. It is engineering of this character that indicates the possibilities in the county field.

At New Orleans

Municipal engineering activities are well ordered at New Orleans. In this important department of city business New Orleans has set some very good examples to other American cities, as the leading article in this issue amply demonstrates. Engineering work in that city has been particularly well handled for a good many years. This reflects credit on the engineers and also on the non-technical city officials who have had the good sense not to interfere with the engineers.

Of very special interest and significance are the facts that the water, sewerage and drainage facilities of the city are under unified management and that the general superintendent of the construction and operating board has occupied his position of responsible engineering head of this Sewerage and Water Board for nineteen years. This has given him the opportunity to do much splendid work and municipal engineers throughout the country are very proud of the results Mr. Earl has achieved at New Orleans. Associated with him are many good engineers who also have been permitted to retain their offices for a good many years and have fairly won the praise of their chief and the gratitude of their community.

It is only natural that where there was much interesting municipal engineering work to do, with competent engineers to do it, that many important and helpful innovations have been introduced, some of which have already been widely adopted by other cities. Also, because of the unification of management of the three utility systems and because men in the various departments were given opportunity to exercise initiative, and, in some cases, to disregard precedent and ordinary procedure, many improvements over usual methods and procedure have been effected. Many of the more important of these innovations and improvements are described in the leading article in this issue.

The Other Man's Prices

"My prices are reasonable, but the other man's prices are altogether too high." This seems to be a very general conviction at this time. The prices in every line are high in comparison with the prices of 1916. In each line the prices are considered fair and just by those engaged in that line, but this set of men regards with suspicion the "high" prices set with equal honesty by the other fellow. Isn't it about time we realized that we are all in the same boat, as usual; that all prices are high and must be high and must continue high for an indefinite period?

It naturally comes as a surprise to find the price of a commodity much higher than when we were last interested in that commodity. In some unreasonable way it seems the price should be the same as it was before the war. It is much like revisiting the scenes of childhood to look up old friends. For years we have carried in memory the picture of a boy. How unnatural it at first seems to find that he, too, has grown to man's stature just like ourselves! A moment's reflection readjusts us; of course, the other boy grew up, too. That is the price situation in a nutshell; the other man's prices just naturally grew up, too.

War Trucks Will Not Drug Market

In case public works contractors or local authorities are delaying the purchase of motor trucks in the expectation that they will have the opportunity to purchase at bargain prices motor trucks used for the transportation of men and materials during the war, they should abandon this idea, for it is reliably stated that such trucks will not find their way back into the market.

It should be remembered that war trucks were subjected to such hard usage that when discarded from military service they are, in most cases, unfit for further use. Some trucks are overhauled and kept in service, which is still going on, but many are scrapped on the ground without even being taken to a salvage dump. These worn-out trucks will have to be replaced by new trucks, and it is doubtful if the number of trucks now contracted for will be sufficient to take care of present needs.

The ending of the war has not relieved transportation difficulties in Europe. The army of occupation must be served and the large present and prospective troop movements rather add to transportation demands. The feeding of the central empires also calls for much trucking, as does the return to their homes of refugees. There is to be much real "reconstruction" in Europe, and until the devastated regions are restored there will be no falling off in the use of trucks in Europe.

In view of these facts, those who need trucks should go into the market for them now.

Unique Features of Unified Operation of Water, Sewerage and Drainage Facilities at New Orleans, La.

Many Innovations and Improvements Over Usual Methods and Procedure

By George G. Earl, General Superintendent, Sewerage and Water Board, New Orleans, La.

The city of New Orleans, starting with its drainage problem in 1895 and with its sewerage and water problems in 1900, to date, has expended about $32,000,000 in the construction of these systems, and now has something like 2,200 miles of underground sewerage, water or drainage arteries of various kinds under its maintenance, and some 18 pumping stations, two power stations and two water purification stations in operation, all involving operation expenditures of about $1,000,000 a year.

Drainage Work

The drainage work was started by the New Orleans Drainage Commission, and when sewerage and water systems were undertaken this drainage commission was made a part of the sewerage and water board, with provision for early merging of the two boards, which was effected in 1903, and resulted, as a whole, in a unification of management from the very inception of the original drainage construction and in the consistent development of the work on all three systems by forces which have been continuously employed upon them, first in planning the original works, then in their construction and in their maintenance and operation, and finally in their gradual extension and improvement.

Extent of Drainage Works

As a result of these works, over 30,000 acres of land, all of which is from 8 to 22 ft. below high water in the Mississippi river, which bounds the city on its south side for a distance of about 11 miles and two thirds of which is below high water level in Lake Pontchartrain, which bounds the city on its north side, has been effectively drained and is constantly maintained in a well drained condition, and the well populated area of the city, including about half the drained area and covering about 600 miles of streets, has been fully served with water and sewerage facilities, and has had practically all of the premises therein connected with both water and sewerage systems and provided with modern plumbing facilities, even the plumbing inspection of which has been under the jurisdiction of the Sewerage and Water Board.

Death Rate Decreases One-Third

With these developments, and made possible in large degree only by them, the total death rate of the city has decreased about one-third. Malaria has practically been eliminated and the whole general aspect and sanitary and living conditions of the city have been so improved that New Orleans today ranks with the best cities of the country in all of these respects.

In all three systems most unusual problems were presented, and experience elsewhere was not a safe guide in overcoming local conditions. Due to the unification of management and the continuous opportunity for gradual development and because men in various departments of the Board's service were given opportunity to exercise initiative, and, where necessary, disregard precedent and ordinary procedure in the conduct of their work, there have been many innovations and improvements over usual methods and procedure effected and much most useful information collected.

Many Innovations and Improvements Effected

The annual reports of the Board have treated of these from year to year but a brief review of some of the more important of these things may be of interest.

Soil Vibration and Surface Settlement

One of the problems which most seriously affects all underground and surface structures in New Orleans has to do with vibration and surface settlement. Saturated clay is subject to very great shrinkage as its saturation is reduced, and roots, stumps and peaty formations to even greater shrinkage. As a result, irregular surface settlement occurs in newly drained areas which were originally at or near gulf level, and structures resting on the earth with shallow foundations have a decreasing amount of settlement as the depth of their foundations increase. This causes manholes, and other appendages to underground structures which extend to the surface, gradually to raise above paved surfaces; to cause drainage openings that were set in surface depressions to become, instead, high spots; to throw irregular settlement strains into shallow water mains, and to do unspeakable things to surface pavements and the line, grade and joints of street railways. In certain areas, vibration, due to ordinary street traffic where heavily loaded trucks of certain objectionable character are used, is seriously felt in the lead joints of water mains; and nearly everywhere in the city steam railroads passing over water mains tend to cause leakage by vibration.

Even in the layout of the drainage systems and the lifts required at drainage pumping stations the necessity to remove the water from distant low areas, a foot or two lower than they were originally, must be taken into consideration.

Again, the system of bench marks from which all construction is built and extended itself constitutes a perpetual problem, and must be constantly checked up from certain pile supported structures which themselves are not too heavily loaded.

Unusual Rainfall Produces Special Pumping Problems

One of the greatest problems in New Orleans has been to take care of the pumping necessitated by the rather unusual rainfall. This combined with the flat topograph and the large area to be drained has presented very serious difficulties.

Rainfall

In 1895 when the drainage problem was first being studied six recording rain guages were placed in various portions of the city. These guages have been maintained ever since and they afford most interesting and valuable data.

The following tabulation of monthly and annual maximum, minimum and average rainfalls for this 24 year period is interesting.

	Maximum	Minimum	Average
January	7.65	0.75	3.47
February	13.27	1.29	4.58
March	11.77	1.23	4.37
April	12.64	0.66	4.71
May	13.98	0.10	4.09
June	10.48	1.21	5.19
July	10.93	2.51	6.20
August	9.21	3.01	5.55
September	16.01	0.39	5.29
October	12.14	0.60	2.96
November	6.32	0.21	2.38
December	13.18	1.62	4.90
Per annum	74.68	33.51	53.82

Far more interesting and useful, however, is the following tabulation which indicates the maximum amount of rainfall to be expected in New Orleans within any given time interval and approximates the average annual maximum amount for the same time interval.

Rainfall Intensities

Based on rainfall records from six automatic guages at New Orleans for 24 years, from 1895 to 1918 inclusive, the maximum amounts of rainfall which have occurred within given time intervals are as per column No. 1, and the approximate average of the maximum amounts for each year for the same time intervals are as per column No. 2.

Time Interval	Column No. 1	Column No. 2
3 Consecutive minutes	0.63	0.33
5 Consecutive minutes	0.83	0.47
15 Consecutive minutes	1.73	0.87
30 Consecutive minutes	2.63	1.48
45 Consecutive minutes	2.99	1.70
1 Hour	3.52	1.78
2 Consecutive hours	4.64	2.30
3 Consecutive hours	5.80	2.78
4 Consecutive hours	6.17	2.98
5 Consecutive hours	7.03	3.20
10 Consecutive hours	7.60	3.90
15½ Consecutive hours	9.21	4.30
15 Consecutive days	22.24	5.00
30 Consecutive days	23.00	7.00
1 Calendar month	16.01	6.20
2 Consecutive calendar months	26.62	11.75
3 Consecutive calendar months	30.81	17.04
4 Consecutive calendar months	36.48	22.23
5 Consecutive calendar months	41.75	26.32
6 Consecutive calendar months	47.06	31.03
1 Calendar year	74.68	53.82

Platted up to the 15 hour period column No. 1 above makes a reasonably regular curve. Until Oct. 29, 1918, it was badly "broken backed" at the one hour period with a 2.8-in. maximum. The 3.52-in. above recorded for one hour is from a perfect and fully checked automatic record of a rain so steady that it did not crowd the record sheet at any point and was below several other recorded rates up to the 30-in. period, and in fact, did not impress one at all as a very unusual rainfall either on the record sheet or in observation of the rain as it fell.

Drainage Pumping Stations

There are seven pumping stations serving the drainage system, with an aggregate capacity of about 7,000,000,000 gals. per day. Much of the drainage has to be pumped twice, and sometimes part of it has to be pumped four times. Pumping stations which deliver into the high level outfall canals have to lift the water 6 to 14 ft. and those making an intermediate lift have to lift it anywhere from 2½ to 9 ft., usually the lower the lift required the more imminent is the need for efficient pumping.

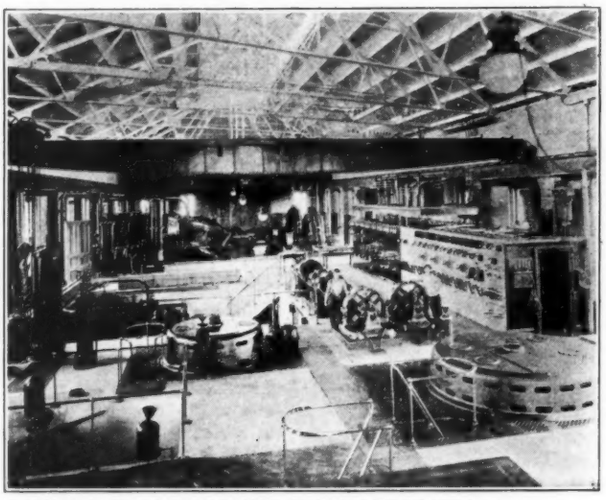
When a considerable rainfall occurs the various pumping stations will begin to get its full effect in from 15 minutes to 1 hour and 30 minutes after the rain begins. During this interval, steam must be raised or increased, electric generators started, and enough pumps gotten into operation to pump the water which arrives at each pumping station just as fast as it becomes available for pumping.

Ordinary Pumping Facilities Insufficient

The actual time interval between an empty drain on the suction side of a drainage station and a drain filled to its flood slope and ready to begin to retard the flow behind it, or even to overflow the surface of the ground at the pumping station is often only a very few minutes and when the drain delivery capacity to a pumping station is anywhere from 1,000 to 2,500 cu. ft. per second it is vital to be able to start enough pumping units within this short interval, and equally vital that these units be capable of doing efficient work in the conversion of power into water lifted throughout the extreme range of lifts required, with screw pumps of 250 cu. ft. per second capacity capable of a 54% efficiency at a 5 ft. lift and dropping to about 30% at a 2 ft. or an 8 ft. lift at the intermediate lift stations, and with centrifugal pumps of say 300 cu. ft. per second capacity, capable of 68% efficiency at an 11 ft. lift but only of say 40% at a 4 or a 13 ft. lift, these conditions could not be satifactorily met. Too many units were required, and too large a proportion of their work was at lifts too far from that at which these units could work efficiently. Further, most of the original pumps were set down in pits to avoid the necessity of priming and operated by motors placed over them on vertical shafts. This necessitated very large gates and check gates to prevent back flow if the motors went out of step and made the whole outfit very difficult of access for maintenance and repair. With this experience in view it was determined when large increases in pumping capacity were undertaking to build the largest possible units, to make them accessible for painting, repair and maintenance from the end of their suction to the end of their discharge, to avoid all gates or check gates, and to seek if possible, a form of pump capable of reasonably efficient work for the full range of lift required.

Screw Pumps at Syphon Summits

To meet these conditions, screw type pumps were designed to be set in at the summits of a syphon passing over a wall which constituted the division between the suction and discharge side of the pumps. Eleven of these have been built and put into operation. They were designed under the immediate direction of Mr. A. B. Wood, Mechanical Engineer for the Sewerage and Water Board. They were built by the



INTERIOR VIEW OF DRAINAGE STATION NO. 1, NEW ORLEANS, LA.

Nordberg Engine Co. of Milwaukee, under a contract which did not even guarantee that they would pump water at all. Their capacity, depending upon lift, ranges from 400 to 700 cu. ft. per second, their efficiency at best point approximates 80% on lifts measured accurately from suction basin to discharge basin and quantities measured in a flume under excellent conditions for accuracy, and they show a very flat efficiency curve. These pumps are 12 ft. in diameter on the discharge side of their runners. They are provided with an automatic arrangement for freeing the blades of any trash which might otherwise interfere with their efficiency. They are operated by synchronous motors at a speed of 75 revolution per minute at the intermediate lift stations and of 83 1-3 revolutions per minute at the final discharge stations, and in both cases they have proven themselves able to cover the entire range of lift required without falling below 60% efficiency either at the lowest or highest lifts.

Special Screw Pumps Highly Satisfactory

Their cost to the Sewerage and Water Board per unit of capacity has been much less than that of former installations and every advantage which we had expected in economy and efficiency of operation has been fully realized. Rotrex Vacuum pumps of large capacity are used for priming these pumps, as soon as the water covers their suction and discharge ends they can be partially primed. When the water rises high enough to warrant the starting of a pump, the throwing of the switch starts the motor in the empty case and a little more priming brings the water high enough on the pump blades to start the full flow which, however, comes on

slowly enough to avoid stalling the synchronous motors. In case of any failure of power the vacuum is automatically broken and there is no back flow through the pump casing and, therefore, no necessity for large check gates or any other form of gates.

The difficulty and costs avoided by pumps set up in this way we have found to over balance many times the single added difficulty of priming, and the completed installation of eleven of these new large units at six of the main drainage stations has shown most magnificent results in every respect.

Sewage Pumping Problems

In sewage pumping, problems of a different nature but equally vital to the maintenance of economical and satisfactory operating conditions have arisen. The capacity of the main trunk sewer line and of the original force main from the central sewage pumping station to the river were over-taxed at times for short intervals much sooner than had been expected, because the fact of the increased porosity of the soil due to shrinkage following drainage had not been fully realized.

Effect of Soil Peculiarities on Sewage Pumping

The soil of New Orleans when saturated in its original condition passes water only very slowly; frequently excavations in continuous execution required no pumping at all, although they would gradually fill with water to very nearly the surface if left standing open for a few days. With the soil in this condition seepage or ground water finding its way to sewers would be nearly a constant small amount, and it had been estimated that about one-third of the total rainfall going off as a nearly constant flow would have to be handled through the sewers. Following effective surface drainage through main drains of considerable depth to prevent long standing surface saturation, and effective underdrainage by the sewers, the whole nature of this soil is changed; it has become extremely porous, and during long dry spells exposed soil surfaces crack open with deep cracks, and as a result rains, especially those following long dry spells, find ready access to the separate system of sewers, with the result that at such times the sewers are heavily taxed with seepage water flow.

The main sewer, which still serves the major portion of the city, the main pumping station and the existing 48 in. force main through which its flow is forced 7,000 ft. to the Mississippi river, could only be designed, with resources available, to take care of the needs of the early future, with additional intercepters, force mains and pumps called for in future extensions to be constructed as population, area covered, and run off required.

To keep up with the original intention one large intercepting sewer, one additional 48 in. cast iron discharge main, and another large pump were due to be built several years ago, not because the dry weather flow had reached the capacity of the system originally provided but because the occasional flow following certain heavy rains derived from a very large area was greater than this capacity.

Electrical Substituted for Steam Pumping

With the financial limitations existing it barely seemed wise, in the face of other more pressing needs, to invest in the extensions which the original plan called for, and the emergency was met initially by providing one new electrically-driven, two-speed centrifugal pump at the central sewage pumping station capable of delivering from 37 to 57 million gallons daily at 43 to 35 ft. lifts, with efficiencies ranging from 69% to 83% at 248 r.p.m. or of delivering from 70 to 88 million gallons daily at 87 to 72 ft. lifts with efficiencies ranging from 80% to 84%, thus doubling the quantity of flow which the existing 48 in. force main can take care of. This substituted electrical for steam operation of the central sewage pumping station, greatly reducing the force of attendants required and permitted the removal of the major portion of its boiler capacity and part of its electric generator capacity to the water works plant where it has been found best to centralize the main power system, and, despite the additional lift upon infrequent occasions, has actually resulted in reduced fuel consumption per unit of sewage discharged.

Intermediate Lift Sewage Pumping Stations

Part of the problem of sewage pumping and disposal, however, was at intermediate lift pumping stations at the other end of the main sewer lines which delivered the sewage by gravity to the central sewage pumping station. These stations now serve an area over twice as large as was originally intended for delivery through the existing main sewer. Only a fraction of the pumping capacity ultimately intended at each of these stations was originally installed.

The effort to operate seven pumping stations each serving a large area with its pumps automatically stopped and started and without any screening of the sewage was rather bold in 1900 when it was proposed. A great deal of study was given to the original design for these small stations, and pumps of the most open type to permit the passage of anything that might enter them were called for; in fact the specification that the pumps should pass a 3-in. ball caused protest by the contractor and very low guarantees as to efficiency. These stations went into operation in 1906-1907, and at first gave perfectly satisfactory results, because the main flow through the sewers was a ground water flow.

Rags Obstruct Pumps

As connections were increased one trouble began to manifest itself, viz, rags. Stopping and starting at predetermined levels on the suction side of the stations was always reliable, but with increasing connections and increasing flow the obstruction of the pumps by rags became a more and more serious matter, first decreasing the efficiency of the pumps and requiring the occasional opening of manhole plates for the removal of a few rags, and progressing until it became necessary to visit these stations two or three times a day for the removal of rags from the pump runners, and even then the accumulation was so rapid that the pumps never operated at capacity and the sewers were not being pumped out low enough to obtain grade line flow conditions. To abandon automatic operation without screening for seven stations and eventually for some 20 relifting stations that will be required to serve the developing area of New Orleans would necessitate the employment of 21 additional attendants plus a screening removal service now, and eventually of 60 additional attendants, or an annual expenditure now of about $35,000 and eventually of $95,000, all because people will throw rags into their toilets, although it is against the law to do so, and centrifugal or other electrically operated pumps cannot operate efficiently or to capacity with rags or similar matter which can be collected and hang on their blades.

Pumps Designed to Pass Anything Entering Them

Automatic arrangements for cleaning the blades of the pumps or for collecting screenings before the sewage entered the pumps were carefully considered but did not seem to give a reasonable hope of relief. We could see nothing short of passing the sewage as freely and as safely through the pumps as it passes through the sewer itself that would satisfy the requirements of automatically operated relifting sewage pumping stations. Initial pump efficiency might go to anything and still give a higher actual operating efficiency than rag obstructed pumps would give and save so much in cost of attendance and screenings removal as to make a pump that would pass anything which could enter it a paragon of economy. The writer had for years the belief that a bent T as a pump runner would pump water and pass anything that could enter it, and Mr. A. B. Wood, who is directly in charge of the Board's sewerage and water works pumping systems, undertook to design enough efficiency into something that could

not be obstructed to warrant its use. His studies indicated something better than 60% efficiency for a runner and pump that looked on paper as though it could not be obstructed by anything that could possibly enter it, and pump casings and motors enough to cover the needs of all of the existing intermediate lift stations were ordered, fortunately before war prices had become effective.

Characteristics of Special Obstruction-Proof Pumps

The runners were cast in a local foundry and finished in the Sewerage and Water Board shops, and most of these relifting stations, especially the larger ones, are now operating with these new pumps. Some of them have been in operation over two years; they show an efficiency of about 70%, with most desirable characteristics, and are not in the least affected in capacity or efficiency by anything that can enter them. The sewage enters each pump suction through a 24 in. pipe, reducing to 12 in. at the entrance and exit of the pump, and a 12 in. ball, or an indefinite amount of anything that could pass a well rounded 12 in. T, passes these pumps without the least trouble. These stations therefore are now just a part of the run of the sewer. A daily visit to each of them is a precaution and by no means a necessity.

At Flood Periods Sewage Pumped to Drainage Canals

Another automatic feature, however, has been added. These stations, as before stated, are serving areas twice as large as the system into which they discharge was intended eventually to serve, and when great rains occur they are delivering more water to the sewers than these areas will yield when they are fully provided with local drains and paved streets, and are far more densely populated, being a much greater flow than the main brick sewer and central pumping station can take care of. This delivery is of highly diluted sewage made at a time when the main drainage canals are themselves rivers of considerable magnitude; at such times delivery of this sewage into the large masonry lined and covered drainage canals is unobjectionable, and is the only way possible to continue to render service. Connections, therefore, from the discharge side of these pumping stations to the nearest main drainage canals, usually only a block or two away, have been made, and automatic arrangements provided whereby the opening to the discharge sewer is closed and to the nearest drainage canal is opened when the discharge sewer is overcharged to any adjustable predetermined elevation, and this condition is reversed when the level of the water has fallen to another adjustable predetermined lower elevation in the discharge sewer.

This is the reverse of a procedure which has been in effect for some years, viz, the discharge of the dry weather flow from the main drainage canal, serving the central section of the city, into the main sewer so long as the main sewer has capacity to receive it by an automatically operated gate in a connecting passage between the sewer and this main drain. Both procedures are equally logical and beneficial. Small amounts of drainage and street washings became septic in the very large lateral drains of the storm drainage system, which cannot possibly be maintained free from obstruction of sand, etc., and can only be adequately flushed by great storms, and the dry weather drainage flow from some areas is therefore more objectionable than sewage promptly collected in separate sewers which fit their work and are maintained always clean and unobstructed.

It is further true that in transit through the large masonry lined drainage canals even the dry weather flow acumulated from one of the sewage relifting stations is adequate to maintain good flow conditions, and would be no more objectionable and probably better combined with the accumulated dry weather flow from the lateral drains than the last named flow alone.

Probable Deviation From Original Plans

It seems more than probable, therefore, that the ultimate development in New Orleans will depart somewhat from the original intention, and that economy in ultimate first cost and more prompt and effective service with both systems will result.

The original intention was a strictly separate system of sewers discharging through pumps and force mains into the Mississippi river, and another entirely separate system of surface drainage discharging its dry weather and small storm flow through pumps into Bayou Bienvenue leading to Lake Borgne some 16 miles eastward of the city, and the excess water from the larger storms through pumps into Lake Pontchartrain on the northern boundary of the city. This requires for the sewerage many miles of trunk line sewers connecting between relifting stations and large force mains discharging into the Mississippi river which can be omitted if the proper masonry lined main drains can be constructed ahead of the sewers, and the sewage relifting stations can discharge into these main drains, all of which deliver toward Bayou Bienvenue and Lake Borgne, leaving it to the future to decide how much, if any, of the combined dry weather flow from the local lateral drains and the sewers shall be delivered through a force main at a high lift into the Mississippi river, or whether

DISCHARGE FROM ONE WOOD PUMP AT DRAINAGE PUMPING STATION NO. 1, NEW ORLEANS, LA.

some additional flushing flow shall be furnished and the whole be sent at a low lift into the tidal Bayou Bienvenue.

The effect of the main drainage of an area of some 30,000 acres capable of carrying over 1,200 miles of streets, and the tendency for population to spread out over this vast area and demand for a widely scattered population the same facilities which already exist over 600 miles of streets covering half of the area and itself not fully populated, and accommodating 95% of the present population of the city, is creating most serious problems in connection with the sewerage, water and local drainage service to these sparsely settled areas.

Financing Improvements

New Orleans has arranged for the building of its sewerage and water works system, including connections to the property line and the main drainage system, from the proceeds of a tax levied equally against the assessed values of all property within the city limits whether said property gets any benefit from said systems or not, and as soon as the main drainage system converts a tide level swamp into drained land someone starts an addition to the city and wants sewerage and water extensions because he is paying the sewerage, water and drainage tax. The fact that his land has any value at all because it already has drainage and that the expenditure to give drainage has been far more than the tax derived from his particular area warrants, impresses him not at all.

Illogical Demands for Extensions

The writer has long advocated the idea, expressed by the homely proverb that "every tub should stand on its own bottom"—in other words that "every item of service of any kind should be paid for at its approximate cost by the party for whom it is performed." If the geenral tax for these three systems were separated and only applied to property benefited by them, and if it were only adequate to cover these portions of the systems of general applicability leaving to each property to pay a fixed average cost for sewer connections and for water meters and connections of various sizes, and a cost per square foot for water main extensions and sewer extensions and lateral drainage extensions, it would do a great deal to prevent illogical demands for such extensions, and to force the city growth to conform to such logical and continuous extension from well defined centers that the financial ability of the city could keep pace with the requirements and maintain these services effective to the whole of the population all the time.

Unused land held at high prices in desirable areas and depreciating ill-kept and often unoccupied premises in other areas, all of which are already fully served with adequate sanitary facilitis, are in large part the cause and in still greater degree the result of the too rapid extension of the suburbs.

Injustice to Majority

It should be obvious that the first cost of sanitary improvements, of transportation, of lighting, and in fact of all public service facilities as well as the cost of their maintenance and operation, must be proportionately greater for a given number of population as the mileage of streets over which these services must be extended to serve said population increases, and it is most unfair if the vast majority of the population of a city must suffer in the character of service given or has to pay rates and taxes far in excess of the cost of these services for them in order that an insignificant minority may obtain equal service at a payment in rates or taxes far below the cost of the service which they receive or demand because the minority has chosen to buy and build over scattered lots in outlying areas.

Reinforcing the Systems

The New Orleans Sewerage and Water Board has gone as far as it can in extending the facilities over the widest possible area, and has now reached the point where in order to maintain the adequate service already given to 95% of the population who are now served, it must begin to strengthen its system in various ways by the addition of items which it would like to have included in its original construction, if more funds had been available, but the omission of which temporarily has not as yet caused any failure or trouble in a 10 year period of service while it has permitted a much wider area and larger population to receive the services than would otherwise be possible fully covering all of the well populated sections of the city and enough close in and as yet sparsely settled area to provide for a very considerable increase in population.

Automatic Operation

Because New Orleans has to depend upon pumping, with practically no reservoir capacity, in its sewerage, water and drainage system, there has been unusual need of automatic apparatus to govern levels or flows under various conditions, and a great deal of apparatus of this character has been employed, resulting in the development of a general system adaptable for the automatic regulation of one or more fluid pressures or flows in any desired relation with one or more other fluid pressures or flows.

Automatic Control in Water Filters

Upon this general system were first built the original variable-rate water filter controllers and proportional flow chemical rate controllers which have been in most satisfactory operation since their first try-out in 1909. Later, apparatus to regulate the rate of flow from the reserve supply clear water reservoirs, and other apparatus to open or close connections between the sewerage and drainage systems at many points depending upon any desired conditions of relative pressure in adjacent sewers and drains, has been added, and still later when liquid chlorine sterilization of the filtered water was undertaken as a final precaution, it was arranged to draw very small flows of water from the discharge side of each pump delivering water into the distribution system, said small flows bearing a constant and common ratio to the individual pump discharge, to add a proportional flow of chlorine gas to these combined withdrawn flows governing the chlorine flow after it leaves its original container at a constant pressure below atmospheric pressure to prevent chlorine leaks, and to reintroduce the chlorine solution thus made to the supply approaching the pump suctions. The withdrawn flow from each pump passed through an ordinary disk meter can integrate and record the work of each pump, and the combined withdrawn flows passed through a similar meter can integrate and record the total delivery of water into the distribution system. Similar apparatus introducing a very small proportional flow of clear water into the 48 in. discharge main leading from the main sewage pumping station and recording said introduced flow, and another governing the effluent flow from a filter and recording same on a 7 day chart, have also been installed.

Use of Equal Pressure Diaphragms

The introduction or withdrawal of a flow proportional to a varying rate of main flow, or the government of two flows to maintain them always proportional to one another, is effected in the more recent apparatus by what we call "equal pressure diaphragms" which are limber, light diaphragms that offer practically no resistance to motion in either direction for the full extent of motion required of them, the function performed by one of said diaphragms being in all cases to maintain either exactly the same pressure or a constant almost infinitely small amount more or less pressure on one side of said diaphragm than exists on its opposite side, through the action of a light balanced valve operated by the diaphragm and never required to effect a large amount of pressure absorption.

The first diaphragms of this character were put into operation over three years ago, have been in constant operation ever since without change or repair, and show no indication of trouble. Pressure regulation of this character with properly constructed apparatus is instant and exact, as though the governed and governing pressure were from a common source, and proportional flow or other operations depending upon it show wonderful consistency in every test which we have ever made.

Advantages of Proportional Flow Apparatus

It is well known that ordinary Venturi measurements can only cover a small range of flows between velocities too low to give sufficient differences of pressure for accurate indication or integration through apparatus operated directly by these small differences of pressure, and too high for permissible amounts of pressure absorption; we find proportional flows are practicable for much lower velocities than pressure difference apparatus. Further, with proportional flow apparatus, individual main flows like filter effluents or pump suctions or discharges, etc., which have each usually a relatively small range can be individually paralleled through restrictions in pipe lines carrying them which can be made to give ample differences in velocity to provide proportional flows to each of said main flows for such small ranges of flow, so that the utilization of restriction of small extent required often for other uses, or immaterial in their pressure absorption at maximum rates of flow, can be made to give proportional flows bearing a common constant ratio to a plurality of main flows, and the measurement, either at their source or outlet, of these combined proportional flows provides for the measure-

ment of the combined flows without squeezing the combined main flows through other special pressure absorption apparatus for such measurement.

Use of Recording Apparatus to be Extended

A 1 in. disk water meter can be made to give accurate integration for a range of flow of from say ¼ gal. to 30 gals. per minute, and to record these rates of flow as actual flows on a clock driven drum carrying a 7-day chart, in other words can record for a range of flows from 1 to 120, and could, therefore, if desired, record the summation of flows through 20 pipe lines either of which had an extreme range of flow through it of from 1 to 6. We believe that a recording apparatus in which a single 7-day chart can tell an observer accurately whether the output of a plant was 1 or 50 or 120 million gals. in 24 hours, or 3,500 or 175,000 or 420,000 gals. in any given 5 minute interval up to the instant position of the recording pen is far more worth the cost of installation plus the cost of charts and time for their placement and removal, and expect gradually to add to the recording apparatus of this type already installed, at least enough to get accurate data as to the run off from some of the automatically operated sewage pumping stations. Similar recording of some of the drainage stations would be of very great value, but unfortunately the original pumps installed at these drainage stations are submerged, with suction and discharge lines buried in masonry and not properly formed to give any pressure difference which would afford a reasonably accurate function of their flow.

It would therefore only be practicable to record the flow through the new pumps, the output of the old pumps being calculated or estimated from station records taken when the operating forces are far more interested in getting water moved than in getting accurate records of the time of starting and stopping pumps, water levels, etc., etc., from which data the portion of the station output due to the older pumps would have to be estimated. Partial records that must be calculated or corrected by other records are usually never so calculated or corrected and are of very doubtful value. For a complete new plant we would expect to include recording apparatus that would give total station output whether it be in gallons of filter effluent or water pumped, or pounds of gas in a gas flow, or heat units above a fixed temperature in a steam flow, by the proper utilization of proportional flow apparatus.

Large Water Meters

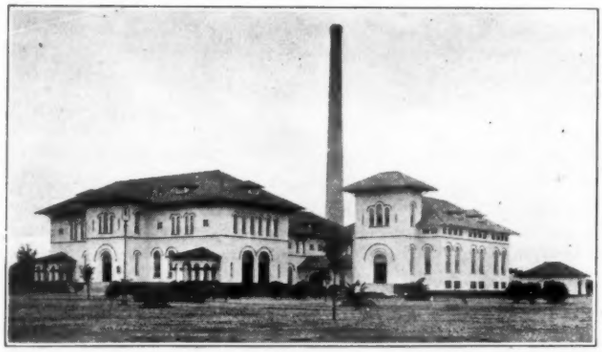
Tests and early experience with large water meters led to the development of a special type of large meter for the Board's use, and since about 1911 the Sewerage and Water Board has bought no water meters larger than 2 ins. This meter consists first of a main check gate which is held closed by a small piston, upon one side of which the pressure on the discharge side of the check gate is effective, the opposite side of said piston being at atmospheric pressure. Around this check gate are two small metered by-passes, each controlling by Corliss Valve Outlets operated by the main valve, and in its axle the one open when the main valve is closed, and entirely closed, the instant the main valve starts to open, and the other opening in proportion to the opening of the main valve. This form of meter is applicable to every use, it gives correct registration on all flow from the smallest which can be accurately registered by a small disk meter in the first named by-pass, i.e., a small fraction of a gallon per minute, up to the full capacity of the pipe line upon which it is placed, maintaining always a sufficient difference of pressure (or pressure absorption) at the main valve for accurate measurement, but opening the main valve more and more as the draft increases to avoid any greater pressure absorption. No strainer or trap of any kind is used ahead of the main valve which is designed to pass anything that can reach it up to a ball of its full diameter, an annular screen of large area protects the pressure chamber which supplies the two small meters. Over 200 meters of this type made in the Sewerage and Water Board shops are now in use. These mostly have either 4 in. or 6 in. main valves, and, depending upon maximum rates of flow desired, 4 in. main valves are used for services from 4 ins. to 8 ins. in diameter, and 6 in. for services from 6 to 12 ins. in diameter.

A 6 in. main valve with gradual reducers leading to it and increasers leading from it when called upon to deliver very large flows through a 12 in. main amounts in effect practically to a 6 in. throat in a 12 in. Venturi.

Measured in pressure absorption at all flows up to maximum delivery capacity, in accuracy of record at all rates of flow from any leak which even a small disk meter can record to maximum rates, in certainty of delivery, in freedom from trouble of any kind, in accessibility for repair in place without shutting off supply from premises, and in applicability to every form of service, from fire connections using no water to railroad stand pipes which have very large consumption with most difficult water hammer conditions, experience since 1911 with this type of meter in New Orleans has more than warranted its development.

Probable Unrecorded Flow Through Small Meters

One of the considerations which have impressed itself upon the writer in connection with fully metered water supplies is the fact that there is a certain rate of small flow due to leakage which no meter can record. A ⅝ in. disk meter in New Orleans is purchased under specifications requiring at least 90% registration at 1-6 gal. per minute flow, and at leaest 97% registration at 1-3 gal. per minute flow. At flows much below 1-6 gal. per minute most ⅝ in. meters will not register at all, and with the least swelling of disk or sticking anywhere they will fail to register at much larger flows, sometimes up to ½ gal. per minute. Even at 1-14 gal. per minute of constant leakage flow there is an unrecorded waste of 100 gals. per day and since the average meter record per connection in New Orleans indicates less than 200 gals. of use per day per house it is obvious that there could be a constant leakage of 100 gals. per house unrecorded as against this 200 gals. of recorded consumption, or 50% under registration on the small consumer flow. When the length of pipe lines, the number of joints and openings and particularly the usual character of closet flushing tanks which have an outlet valve which must seat under only a few inches of water pressure and be maintained perfectly water-tight to avoid small leakage, are all taken into consideration, is it not probable that the differences which are found between metered supply into fully metered distribution systems and metered consumption therefrom, are far more to be attributed to meter under-registration due to very small leaks inside of consumer's premises than is usually assumed? The writer believes that even when all services are metered, as they undoubtedly should be, the character of plumbing inside of consumer's premises is still of very great importance in its bearing upon water consump-



EXTERIOR VIEW OF POWER AND PUMPING STATION AT MAIN WATER PURIFICATION PLANT, NEW ORLEANS, LA.

tion. Leaks start too small to record on the meter, and until they are reflected in the consumer's bill for water they are not repaired. Often, many small leaks are most difficult to discover at all, and cannot possibly attract notice. If the average meter in New Orleans has an unrecorded flow of 1/14 gal. per minute or 100 gals. per day it means 5,500,000 gals. per day of under recording of flow or about 1/6 of the total amount of water supplied to the distribution system.

Simple Apparatus to Determine Rate of Small Leakage Flows

The writer has made considerable study to find a way to determine the existence and rate of very small leakage flows, and has suggested a simple apparatus with which it is intended to test a lot of representative premises during times of supposedly zero consumption, which can be placed at any water connection and connected into the space usually occupied by the meter, the meter itself may be connected into the apparatus, and by its use the recording accuracy of the meter at all rates of flow can be determined, and in addition flows escaping toward the premises no matter how small can be read by an observer.

Troubles With Contractors

The earlier construction works of these three systems were erected under contracts of the usual form often including guarantees of efficiency or of results otherwise, and allowing more or less discretion in design of machinery or in method of conduct of other work on the part of the contractor.

The law requires the Sewerage and Water Board to let its contracts to the lowest bidder on any given plans and specifications, leaving no discretions, and more or less of the usual troubles followed these usual forms of contracts.

The contractors during construction often claim that they must have their own way in all things if their guarantees are to hold and after construction, if their guarantees are not met, that conditions over which they had no control were responsible. As a result of this, and especially of high bids, which were rejected on a lot of sewer contracts in 1907, the Sewerage and Water Board concluded itself to assume full authority and responsibility and subsequently has executed much of its work under the direct supervision of its own forces eliminating any general contractor.

Day Labor Plan Successfully Employed

All sewerage extensions since 1907, and all water extensions since 1908, as well as all house connection to both systems and many other things, have been done in this way with very great saving in cost and material improvement in the character of the work or results otherwise procured. This would not have been possible when these works were started, but with the building up of the Board's forces through experience and continuous employment in special lines of work, these forces are now far better qualified to design and direct its work in most directions than any contractor less familiar with local conditions.

All Water Services Are Metered

In the operation of the water works system which was started in February, 1909, it was clearly indicated within the first six months that without water meters consumption would go beyond the capacity of the plant before all of the premises of the city were connected with the system and the all-meter system was at once adopted, and by the end of 1910 practically all water connections were metered with the result that the system after ten years is still reasonably ahead of the consumption demand in its capacity.

Meter Rate

In adopting the all-meter system, a meter rate had to be worked out, and after much study of existing rates what is termined a "service charge" in contradistinction to the then well known "ready to serve charge" was adopted, being a definite amount for each size of meter and connection enough to cover the cost of maintaining the service line and meter, and the cost of meter reading, collection, accounting and inspection inside of the consumer's premises; in other words, enough to cover all costs arising from the consumer's tap in the main to the delivery of water to him, and a uniform price was set for water recorded through the consumer's meter, enough to cover all costs arising on the city side of the consumer's tap in the main and fairly chargeable to the "used" capacity of the plant. Leaving the unused or surplus capacity available for fire protection and future growth to be paid for by the tax payers. This system encourages legitimate consumption and discourages waste offering the same incentive to every water consumer to use or save a given amount of water.

There were, as frequently happens, restrictions of various characters in the law creating the Sewerage and Water Board which had to be regarded not only in rate making but in many other respects which are highly objectionable. The method of rate making proposed for New Orleans included an accounting system which would determine the average cost of the various items of service rendered, and proposed from time to time to adjust rates charged to beneficiaries for these items, to meet the varying conditions of cost under which the system had to be operated. This was practicable under the original law which stipulated what costs were to be paid for out of water rates, and what out of taxes, and limited the rates to those that would meet the stipulated costs. Having made rates to meet these certain stipulated costs and lowered these rates until they were barely safe to meet the costs for 1914 conditions, the law was changed so that a large amount of other costs should also be met from these rates, but stipulated that these rates should not be increased beyond those then existing. When war prices and conditions for material and labor were added to this condition it rendered the situation exceedingly difficult.

Service Must be Paid For

The cost of all service must be met somehow, or it will cease to exist. When the water rate payer gets his items of service below this cost, the tax payer usually has to pay the bill in some other form and if the tax payer evades his fair share then some items paid by some rate payer must bear the additional burden. When everyone reaches the conclusion that it is better and fairer for every beneficiary of every service to pay the cost plus a reasonable margin on all of the items of service which he receives, rather than to spend his time in fighting to unload his fair proportion of charges upon someone else's shoulders, thus saving also the time required on the part of the other fellow fighting back, there will be a lot of wasted time and effort saved and available to increase the total amount of all service which all of us can render, which, after all, is the measure of all of the service which all of us can receive.

Organization and Personnel

The organization of the Sewerage and Water Board forces has been worked out not as separate organizations for each of the three systems but rather with a view of obtaining the maximum of efficiency for the service as a whole, and of delegating to each separate department that work which its head and organization can best perform.

Drainage Canals

The maintenance and extension of the main drainage canals and their laterals is under Mr. Alfred Theard. Mr. Theard has been associated with the drainage work from its inception in 1895, in a responsible capacity, was familiar with the rainfall and run-off studies from the start, and responsible for the evolution of the Drainage Collection System which is so successfully meeting the very difficult local drainage requirements.

Water and Sewer Lines

The maintenance and extension of the Sewage Collection and Water Distribution Systems and Connections is under

Mr. John T. Eastwood, who started on the design of these systems in 1900 and has been continuously employed, first on plans and estimates, then in construction merging into maintenance and extension. His interest in his work and his industry and good judgment coupled with his continuous experience in the construction and maintenance of these systems has pulled them through the first ten years of their operation with a spendid record, far better than could have followed under less competent management. With 1,100 miles of water mains and sewers and about 55,000 connections serving 76,000 premises from the mains to the property line on each of these systems, and with 500 miles of storm drains besides extensions always in progress on all three systems, automobile and team and truck service and the maintenance of a central yard for supplies of all kinds and for general repair work is a most important feature.

Central Supply Yard

This yard is operated under the Sewer and Water Maintenance Department, with repair shops, stables, garages, warehouses, track connections and large storage spaces, with locomotive crane for loading, unloading and handling, and with the necessary accounting and checking system and serves all of the above named work, and other departments when called upon, and is far more complete and useful to the work as a whole, and can afford, and be more interesting to, a more competent superintendent in charge, than would be possible if each system had to depend upon its own yard and shop facilities.

Drainage, Pumping and Power Stations

The maintenance and operation and extension of the seven large drainage pumping stations and the power station and transmission lines for their operation is under Mr. Alfred Raymond, who has filled the position since the original installation of this system, and also cooperated most helpfully with other departments of the Sewerage and Water Board service and of the city in his capacity as an electrical engineer. These stations are widely scattered, and several of them relatively inaccessible. Their upkeep is an important factor and they are all provided with a fair equipment of machine tools to permit the regular forces employed in their operation to take care of all ordinary repair work.

Water, Sewage and Power Stations

The maintenance and operation and extension of the water and sewage pumping and power station is under Mr. A. B. Wood, who started under Mr. Raymond at the inception of the drainage service and during the construction of the water and sewerage systems was assigned as mechanical engineer to this service. In the development of the systems it has gradually come about that there is an interchange of power and a complete cooperation in every way between the sewerage and water and the drainage power and pumping systems and the heads of the two departments have worked together in the development of most important improvements in the pumping and power systems which have been in progress during the last several years.

Machine Shop

At the water works pumping station a well equipped machine shop is maintained at which all major repairs on mechanical work are executed and much new work, including smaller pumps and large water meters and much other special apparatus is built. All meter testing and repair is also carried on under this department, at the main water purification and pumping station.

Water Purification

The maintenance operation and extension of the water purification system is under the direction of Mr. John L. Porter, director, who entered the board's service as a sanitary engineer in 1900, took part in the original water purification investigation and thereafter maintained a laboratory for continuous study of the water purification problem and for all cement and other testing, required in large amount, in connection with all departments of the Board's service. Mr. Porter also co-operated in the framing of plumbing regulations and organized the plumbing inspection department taking charge of this work until the water purification system was ready to go into operation, when the plumbing inspection department was turned over to Mr. Geo. A. Middlemiss, who had been an assistant engineer on drainage, sewerage or water works construction from the inception of the drainage work. At the main water purification station a well equipped laboratory is maintained, and all testing work requiring its facilities is taken care of there for all departments of the service.

Reservoir System

Under local soil conditions the maintenance of the rather extensive reservoir system required for the proper preliminary treatment of the Mississippi river water is of itself no small task, and the fact that the first tryout of the New Orleans water purification system was the beginning of a period of continuous and highly successful operation of which there has been no cessation to this time is largely attributable to the foresight, skill and experience of the director of that system.

Accounting

The accounting and general business of the board as well as the water collecting and meter reading are under the direction of the secretary of the board, Mr. F. S. Shields, who has filled this position continuously since the first organization of the Sewerage and Water Board in 1900 and has commanded the confidence and esteem of the board itself and of all of the departments of its service, because he has been consistently cooperative and helpful in every possible direction.

The Sewerage and Water Board

The Sewerage and Water Board itself is composed of 13 members, seven appointed by the mayor of the city, who is ex-officio president of the board, for 14-year terms, from the seven municipal districts into which the city is divided, two of whom are ex-officio members due to their membership on the Board of Liquidation of the City Debt, and three of whom are ex-officio members due to their membership in the Commission Council of the city, the Commission Council and the mayor being elected on four year terms. With the above form of organization for the board itself, any rapid turn over in its membership or policy, even with rapidly changing municipal political conditions is unlikely. The present mayor, the Honorable Martin Behrman is now in the middle of his fourth 4-year term and has consistently supported the board, and cooperated with its departments, and the board, as a whole, has given every possible support and opportunity for the exercise of initiative, and therefore for the performance of the best possible work of which its various departments were capable. Under these favorable conditions the various departments, each having work of sufficient magnitude to command and retain the interest of men of high capacity have far more than justified themselves in the results achieved and have built up, not only at their heads, but also in charge of various sub-departments, and in lower positions, a force of men who are true to themselves, loyal to their work, and to one another and highly skilled in their special lines.

The writer of this article who has been the responsible engineering head of the board's organization for 19 years, believes that under a properly formed public board it requires only a little encouragement in right directions and discouragements in wrong directions, with full recognition everywhere of creditable work, to obtain individual interest and initiative, and to build up a strong, loyal, co-operative organization of this character, for any city, which could be trusted with any extent of responsibility in municipal public service work, and which would be more and more efficient as the responsibility thrust upon it and the authority delegated to it increased.

Public and Private Ownership

The contentions between cities and privately owned public service corporations and the misunderstandings and poor service which frequently result from the mutual effort to get the best of the bargain, are all tending toward public ownership, and such ownership will be a blessing or the reverse, depending first upon whether public management is conducted in the interest of the public as a whole by competent authorities, or is made the plaything of shifting political conditions, and second upon whether or not the public as a whole will tolerate the idea that all service must be paid for at its fair cost, that accounts must be so arranged that the average cost attributable to every item of service rendered, and aggregating the total cost of the whole service including interest and depreciation and every other cost, can be determined, and that the cost so determined, adjusted as required to meet changing conditions, plus a reasonable margin, shall be the price paid by every beneficiary for every item of service rendered. Probably no public service today nearly approximates this condition, and until every public service, in every item, is thus regarded and the nearest practicable approximation of this principal is effected, neither publicly owned nor privately owned public service corporations can render their best service or attain that position of stability in management and of universal public confidence which is essential to their most successful development.

Some Specific Suggestions on the Design and Construction of Modern Wood Block Pavements

By E. A. Fisher, City Engineer, Lakewood, Ohio.

The troubles of bleeding, buckling and decay of wood block paving have occupied the attention of paving engineers for some time. Expansion of the block under conditions of moisture has caused blow-ups, excessive bleeding, curbs pushed out of line and a rolling surface. The use of the old-fashioned sand cushion and sand filled joint has led to uneven surfaces due to shifting and shrinkage of the cushion, it has encouraged decay by providing the very condition best fitted to produce decay. The study of details connected with the above troubles has resulted in the development of a type of pavement designed to meet the objections to older methods of laying creosoted wood block.

The Modern Wood Block Pavement

The modern wood block pavement in its latest development consists of laying block on a pitch cushion applied to a smooth concrete base and filling part of the joint with pitch and the remainder with sand. This method has been followed in Europe but is relatively new to America.

The following are some practical considerations intimately connected with this type of pavement.

Pavement Base

There is a diversity of opinion as to the thickness of concrete base to be used under a given pavement. It is conceded that the load to be carried is the determining factor. It has been the writer's practice to lay no base of less depth than 6 in. for any street. For main thoroughfares with heavy traffic bases 8 to 10 in. in thickness, depending upon the load and soil conditions, are desirable. Since the foundation is really the life of the pavement, the added first cost of a thicker base on heavy traffic streets is money well invested.

The coarse aggregate should be carefully graded and the mortar content so figured as to give an overloading of the voids in the mixture of about 15 percent in order to furnish sufficient mortar to flush coat the top of the concrete. A sidewalk finish is obtained by the use of a roller 6 ft. long, 9 in. in diameter and weighing about 50 lbs. This roller is used transversely of the street after the concrete has been brought to the true contour. The effect of this rolling is to squeeze out the excess water in the surface of the concrete, level the surface and eliminate short waves so objectionable in any pavement. There is a slight tendency for the mortar to pick up behind the roller and leave small corrugations which are removed by floating with a long-handled float. One man can finish much faster than the concrete can be poured and a more efficient and cheaper method of bringing the concrete to a true surface would be hard to devise.

After finishing, the concrete is allowed to cure and set the specified number of days and when perfectly dry, the pitch coat is applied.

Pitch Coat

This pitch coat is a coal tar distillate whose melting point

VIEWS SHOWING CONSTRUCTION PROCEDURE ON MODERN CREOSOTED WOOD BLOCK PAVEMENTS.
Top Row: Pulling Strike Board on Concrete Base, Door St., Toledo-Concrete Roller in Use on Same Base. Bottom Row: Placing Pitch Cushion with Buckets and Squeegees, Superior Street Pavement, Toledo-Wood Blocks being Laid on Same Pitch Cushion.

is between 140 and 150 degrees F. The pitch is heated to a temperature of 250 to 350 degrees F., depending upon the weather and the state of dryness of the concrete, poured from buckets and spread to an even thickness of ⅛ in. with squeegees; care being taken not to overlap and produce uneven thickness of the coat.

The precautions to be taken are (1) to see that the pitch is of the proper melting point and answers the specifications when it is delivered on the work since the practice of keeping large quantities of pitch above the melting point for long periods has a tendency to raise the melting point and to produce too brittle a pitch; (2) to see that the pouring temperature is never below 250 degrees F. and high enough to insure its being workable when it comes in contact with the concrete; (3) to see that the pitch is uniformly distributed, since overlapping or uneven pitching will give trouble later in the rolling, especially if the weather is very cool; (4) to see that the concrete is as near absolutely free from dust as is possible. This may be accomplished by the use of street brooms followed by corn brooms in cool weather or by the use of water in warm weather. The impalpable dust on the top of concrete prevents the adherence of the pitch coat to the concrete.

Creosoted Wood Block Surface

After the pitch coat has cooled and within thirty minutes after applying, the creosoted wood blocks are laid directly on the pitch coat and rolled longitudinally and transversely with a 4 to 7 ton tandem roller. The rolling sets the blocks into the pitch and seals the bottom of the block against the entrance of moisture. Expansion is provided along the curb by an asphalt premolded strip of a thickness depending upon the width of the street.

As soon as the blocks are set and culled and rolled, the joints are filled to a depth of 1 in. with pitch having a melting point of 140 to 150 degrees F., after which sand is spread upon the street in an even layer to the depth of about 1 in. and left to be worn into the joints and into the top of the block by traffic. It has been suggested that it might be better to place ½ in. of sand in the bottom of the joint first and then pitch the joint, the argument being that with pitch on the bottom of the block and in the bottom of the joint that there might be a tendency for the block to float. The writer sees difficulty in getting ½ in. of sand uniformly in all joints and has not seen any blocks float after once having been pitched. The method of pitching the bottom of the joint and of setting the block on the cushion seals the bottom and four sides against the entrance of water at a place where it cannot readily evaporate.

Some practical considerations may not be amiss: (1) The main point to be watched in filling joints, after being assured that the pitch meets the specifications, is the temperature at which it is poured. This is really an important consideration. The writer feels that the proper temperature is between 300 and 350 degrees F. or even higher if the nature of the pitch will stand it. Any chilling, and therefore hardening, of the pitch before it is in its final position in the joint results in a waste of the material on the surface of the block and a gummy, disagreeable street in warm weather. (2) The pitch is poured from buckets onto the surface and squeegeed into the joints. If the joints are filled full on the first application and squeegeed, after settlement there will remain in the joint very uniformly the right amount of pitch, 1 in. for a 3½ in. block. (3) Particular care must be taken thoroughly to clean the surface of the blocks with the squeegee while the pitch is hot. A gummy street from pitching is inexcusable. (4) The sand to be used in filling the remainder of the joint should be clean, sharp and fine enough to flow into the joint.

Treatment of Block

The subject of the proper creosote oil to be used in treating timber for creosoted wood block is an open question and will not be discussed here but the method of treatment is, to the writer's mind, of extreme importance. The usual specification of so many pounds, usually 16, to the cubic foot of timber should carry with it an explicit statement of how the oil is to be applied. After specifying the kind of oil to be used and the temperature at application the modern specification requires pre-steaming at 220 to 240 degrees F. for from 2 to 4 hours, vacuum of 22 in. application of oil at a gradually increasing pressure to 50 lbs. at the end of the first hour, 100 lbs. at the end of the second hour, and not over 150 lbs. during the third hour or until the wood has absorbed the necessary or specified number of pounds of oil per cubic foot. This method is aimed at getting a thorough impregnation of the oil thruout the block. The manufacturer could get 16 lbs. of oil per cubic foot into the block in the first 30 minutes by stepping up the pressure a sufficient amount. After-steaming and vacuum will remove excess oil from near the surface and reduce the tendency to bleed.

Advantages of Lug Block

The writer prefers to use a block having separators or lugs to provide for expansion, space for joint filler, and to furnish foothold for horses and further reduce slipperiness. No doubt many blow-ups on otherwise good wood block streets are due to the lack of sufficient provision for expansion and the use of a separator or lug which will either crush into the side of the next block or be crushed itself seems a sensible and logical method of providing for expansion. It is imperative that the sand used in filling lug block pavement joints shall not contain pebbles so large as to destroy the effect of the lug by bridging from block to block.

The writer has seen wood block pavement laid on streets receiving little or no heavy traffic with results that were not creditable to this type of pavement. Creosoted wood block pavement is essentially a heavy traffic pavement and in addition to furnishing long wear under these conditions, it is sanitary, noiseless, does not reflect light or heat, does not originate dust and is less slippery than sheet asphalt. Its first cost is slightly less than other high class heavy traffic pavements of equal durability.

Summary

The modern creosoted wood block pavement consists of a sufficient concrete base finished to a sidewalk surface made free from undulations by the roller and float method of finishing; a pitch cushion which adheres to the block and seals the bottom against water; properly impregnated long leaf yellow pine block with lugs to take up expansion and prevent excessive bleeding; a pitch filler to one-third the depth of the block which further seals the block against water; the surface of the block cleaned of all pitch; clean, sharp sand in the remainder of the joint and proper expansion along the curb.

The Present Level of Prices, with Special Reference to the Prices of Road-Making Materials

By S. M. Williams, President Highway Industries Association, McKim Bldg., Washington, D. C., in addressing conference of Governors and Mayors at Washington, D. C., on March 5, 1919.

Much has been said during the last three days regarding the present situation concerning public work and especially road building. I would not attempt to argue for unreasonable prices because unreasonable prices cannot be maintained. I have even gone so far as to say definitely to the producers of road building materials that if they are not in a position to justify their prices and reductions are coming, they should be made immediately.

If war permitted an unusual profit in any commodity that margin of profit cannot and should not be continued, but if products only brought during the war a reasonable margin of profit, and in order to maintain that profit, present prices must be continued, it is the duty of you men to uphold them.

Suspicion of Prices

Unfortunately there is a very marked degree of suspicion in

the minds of the public. One industry is awaiting the action of the other with the result we are rapidly approaching a condition which, if not changed quickly, will result seriously to the nation. We should realize that industrial victories, like military victories, are won by courage, patriotism, unity and confidence.

I would remind you that we were five years reaching the present basis of prices and we cannot return to former prices and conditions in a few months. I doubt if we want to go back even if it were possible.

I would also remind you that during the last year there was very little, if any, money made by the producers and manufacturers of road building materials.

Brick Prices for Example

Unfortunately I did not have the privilege of hearing the speech of Governor Cox from Ohio, but read it last night, and while no man in Ohio stands higher in my estimation than Governor Cox, I am afraid that he is working under a misapprehension or from wrong information in regard to road material prices. He referred to the increase in prices of various materials, one of which was brick. I was informed by one of the large producers of brick in Ohio, over the phone last evening, that in November, 1917, his contract prices were $20 per thousand delivered, to which was to be added any increase for labor, fuel and freight. In June, 1918, for deliveries upon the same contracts his price was $25 per thousand and he assumed whatever increase there might have been in labor, fuel and freight rates. In 1919 his price is $25 and while it is true that his fuel has been reduced slightly his increase in the cost of labor since 1917 is considerably more than 100 percent and labor is more than 70 percent of the cost of producing brick.

Another feature surrounding the manufacture of brick is that the manufacturers have met the request of the government to keep labor employed with the result that hundreds of thousands of brick are piled in their various yards and are not being used because of the present attitude toward public improvements. It is needless to say that the employment of this labor cannot continue very long unless there is a different attitude on the part of those responsible for public work.

Cement Prices

I am also afraid Governor Cox's information in regard to the increase on cement was unreliable inasmuch as I am informed from reliable sources that the price of cement at the mills supplying Ohio is 15c per barrel higher than it was one year ago and no higher than ten months ago. During this period of ten months there was one raise in freight rates upon incoming commodities and two wage increases.

I do not believe the road material industries are less patriotic than any other class of people and, notwithstanding the fact that many of their industries were practically closed during the war, they were loyal to every call upon them and today stand ready to meet every obligation to their government.

Commodity Prices, Cotton for Example

Recently I read the following statement from the Cotton Publicity Committee: "The southern farmer has learned that his labor is worth more than four pounds of salt meat, a peck of meal and two or three yams every week—and perhaps a few clothes and a pair of shoes once a year. The southern boy and girl will not live on the farm any longer unless it offers more comforts. The southern people are done with shacks and cabins for homes and streaks of mud for roads. They want houses, well paved roads, good schools, and better opportunities for their children. The southern farmer is going to get a fair price for his labor. Cotton will never go back to starvation prices." Notwithstanding that statement I am reliably informed that the cotton growers are now demanding and waiting for a reduction in the cost of fertilizer and so it goes.

Farm Products Buy More Roads Now Than Formerly

A different attitude was shown by a prominent farmer in reference to road building. He said: "The farmer today can buy more roads with his products than he could a few years ago under former price conditions, and while the cost of road building has gone up, the price which the farmer receives for his products has registered a much higher advance, so that 100 lbs. of milk, or a bushel of grain, will buy more roads today than it would in 1914."

On Monday it was recommended by Lieut. Governor Oglesby, of Illinois, that the government pocket the loss on wheat and pork and allow the farmer to go back to normal conditions. What did he mean by "normal conditions" Does he intend to go back to conditions prior to the war when thousands of men were leaving the farms because of unattractive and unsatisfactory labor conditions or does he mean to allow the farm labor a living wage, and if he allows that, will he be able to reduce the cost of living for the labor entering into the manufacture and production of materials entering into road construction?

Labor Cost

When you consider that at least seventy-five percent of the cost of road construction, from the raw materials to the finished road, is labor, I do not see where we can expect much reduction in road building so long as the wages and the cost of living remain where they are. You can have roads at lower cost, but not without disturbing labor conditions.

Views of an Eminent Economist

I desire to quote from a recent statement from a well known authority, Mr. Irving Fisher, professor of Political Economy of Yale University. Mr. Fisher says:

"At the present time there is a marked halt in production. Industry is slowing down. Unemployment of labor increases. Some industrial concerns are failing to earn profits, and others are suffering the dissipation of their accrued profits because, even by shutting their plants down, they cannot save certain of their expenses or any of their fixed charges. The government's revenues, dependent as they are upon the national income, may fall short at the very time we need them most. In brief, we are threatened with a widespread business depression and from peculiar causes, for the unsound conditions usually preceding a widespread business depression are absent."

No Case Exceptional

"The main reason why business is not going ahead better is that most people expect prices to drop. The merchant is selling, but not buying. The manufacturer holds up the purchase of his raw materials. People quote the disparity between present prices and those prevailing "before the war," and decide they will not buy much until present prices get to "normal." This general conviction that prices are sure to drop is putting a brake upon the entire machinery of production and distribution. Readjustment waits because we keep on waiting for it. We have waited in vain for over three months. It is interesting to observe that many manufacturers think that prices must come down, including the price of labor, but they are ready to demonstrate to you that their own prices cannot come down, nor can they pay lower wages. Almost everything they buy somehow costs twice as much as before the war, and their labor is twice as dear. They cannot pay their labor less, if labor is to meet the increased cost of living. Now, as a matter of fact, when we investigate almost any individual one of the so-called "high prices" for industrial products, we are likely to find that individually it is not high, that is, it is not high relative to the rest. Our quarrel is with the general level of prices."

Prices on New and Permanently Higher Level

"The fundamental practical question confronting business men is whether the general level of prices is giong to fall. In my opinion, it is not going to fall much, if at all. We are on a permanently higher price level and the sooner the business men of the country take this view and adjust themselves to it, the sooner they will save themselves and the nation from the misfortune which will come, if we persist in our present false hope."

"The general level of prices is dependent upon the volume and rapidity of turnover of the circulating medium in relation to the business to be transacted thereby. If the number of dollars circulated by cash and check doubles, while the amount of goods and service exchanged thereby remain constant, prices will about double.

"The great price changes in history have come about in just this manner. The 'price revolution' of the sixteenth century came upon Europe as a result of the great influx of gold and silver from the mines of the New World. Europe was flooded with new money. More centers were used than before in effecting exchanges, and prices became 'high.' People talked then of *temporary* 'inflation,' just as they talk of it now. But it was not temporary; it was a new price level.

Not Clever to Wait

"Business men should face the facts. To talk reverently of 1913-14 prices is to speak a dead language today. The buyers of the country, since the armistice, have made an unexampled attack upon prices through their waiting attitude, and yet price recessions have been insignificant. The reason is that we are on a new high price level, which will be found a stubborn reality. Business men are going to find out that the clever man is not the man who waits, but the one who finds out the new price facts, and acts accordingly."

The surest way to secure a readjustment of conditions, including prices, will be to start industry going and bring it to a normal business basis as quickly as possible. It is not fair to consider today's prices with those of the days when business men were failing because of the general unrest throughout the country which resulted in cut-throat competition, low wages and *of course* low cost of materials.

The value of a citizen to a community is not increased by forcing bankruptcy upon that citizen. Low price of materials under such conditions become high priced, and that is just what will occur in this country if the federal, state and county governmental agencies do not establish confidence in the country by a go-ahead policy in public work. If you men representing the various states and municipalities do not go ahead with your work you cannot expect private capital to do so, and if neither proceeds the result will be serious not only to the road building industries, but the same spirit of "hold-back" will extend to all lines of industry.

The Cost of Delay

The cost of delay in proceeding with your road building programs is in my estimation more serious than the increased cost of construction. The joint committee on Federal Aid in the construction of post roads, sixty-third congress, reported after a careful investigation that the United States was paying annually a penalty in excessive cost of rural hauling of $504,000,000. These figures have increased considerably because commerce to be transported over our roads, combined with the opening of new roads, far exceeds the improvement of roads. They are also based upon horse drawn haulage, consequently, the saving from motor vehicle haulage would greatly increase the penalty. Every state in the union is sharing in that penalty.

One of the main arguments for the recent $200,000,000 increase in the federal aid was that it would encourage the states to go ahead immediately with their road building programs by assisting them in meeting the higher cost of construction, and to accomplish that, the original federal aid law was amended by increasing from $10,000 to $20,000, the cost per mile for federal aid participation.

It has been said that some manufacturers have stated that the price of materials could be reduced but that reduction was being prevented by certain leaders of the industries. If such is the case, and there are sound reasons whereby reductions in price of road building materials may be made, they should be, and without delay, but I would remind you of a statement made during the war by Mr. Edward N. Hurley, based upon government investigation, that many of the manufacturers did not know their cost of production and that 90 percent had not been making any money and 5 percent less than $5,000 per year.

We are sometimes too willing to cry graft and extortion. More than any other nation on earth we stand in need of good roads and thousands of miles of them.

The adjustment of prices to what may be the new normal level can be accompanied by prosperity just as great as we have had during the raising of prices providing we keep right on doing business.

With capital and labor which has been devoted to the war turned into avenues of production for the things which are so essential to our industrial progress and economic life, the earnings of that capital and labor will develop an enormous market for shoes, clothing, food and all the other commodities made for the comfort, or to meet the desires of mankind.

With consuming and purchasing power thus sustained our farms and factories will continue to teem with activity and prosperity will abound throughout the entire land.

With capital and labor fully and profitably employed the only price effect will be the adjustment and probably decline of speculative prices—a result that can but little affect the normal level of legitimate values.

Conclusion

Now, I have endeavored to give you definite, tangible facts which show clearly the fundamentals of the situation. The understanding of this situation if confined solely to this audience can do little to aid in the solution of the immediate and pressing problem.

If the public as a whole can be brought to a quick realization of the facts we can all go ahead confidently and enter the era of great prosperity which is certainly ultimately ahead of America.

I believe that you should be preaching these facts to your communities and should not wait for the logic of events to force the public to the correct understanding.

Machine Finishing Concrete Roads

By E. G. Carr, Consulting Highway Engineer, The Lakewood Engineering Co., Cleveland, Ohio.

A concrete road may be defined as a slab of concrete upon a country roadway to provide a hard surface for traffic under all weather conditions.

It will be assumed in this article that the slab has been properly designed with reference to the character of the soil and the traffic to be carried. These problems must be solved by the knowledge and experience of the engineer. It is the object of this article to direct attention more particularly to the character of the concrete slab and its construction.

Concrete in roads is subjected to more severe conditions than are ordinarily encountered when it is used for other purposes—abrasion of the surface and the pounding effect of traffic which causes strains not common in other concrete structures.

Concrete in Roads Must be Best Obtainable

A continuous slab of concrete on country soil is also subject to expansion and contraction caused by changes in temperature and water absorption. Hence, concrete for roads must be better concrete. It must be more dense and uniform than for most other uses. A small amount of inferior concrete in a wall may be protected and supported by the stronger concrete surrounding it. In a road the traffic hunts out the weak spots with fiendish ingenuity, and these places will fail regardless of how good the surrounding concrete may be.

Concrete cannot be compressed like a bale of cotton, and it can be compacted only by creating a flowing or crawling action in the concrete mass, so that the larger aggregate will settle closer together, and the smaller particles will fill the remaining voids.

Three Methods of Reducing Voids in Concrete

There are three ways in common in molding concrete to

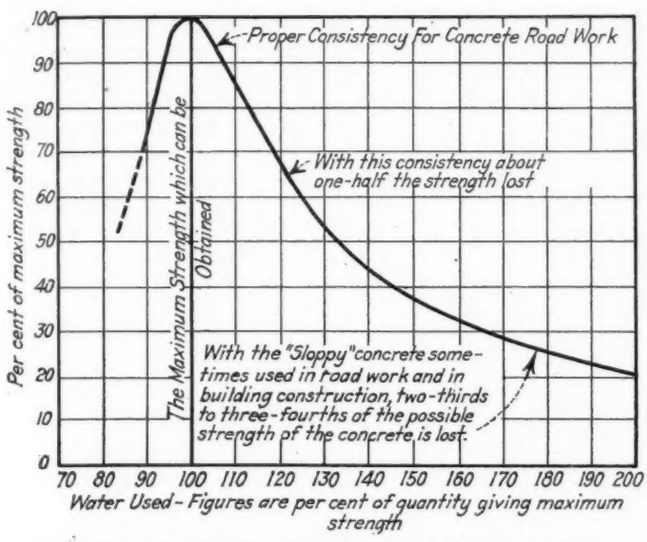

Per cent of maximum strength
100
90
80
70
60
50
40
30
20
10
0
70 80 90 100 110 120 130 140 150 160 170 180 190 200
Water Used - Figures are per cent of quantity giving maximum strength
Proper Consistency For Concrete Road Work
With this consistency about one-half the strength lost
The Maximum Strength which can be Obtained
With the "Sloppy" concrete sometimes used in road work and in building construction, two-thirds to three-fourths of the possible strength of the concrete is lost.

DIAGRAM SHOWING EFFECT OF WATER ON THE STRENGTH OF CONCRETE.

reduce voids. Two are detrimental and one beneficial to the strength of the product and all three generally employed in varying degrees.

One way is to add excess water until the concrete literally flows in place by gravity. Another method is to use finer aggregate so that there will be less voids to fill. The third way is to stir it, tamp it, roll it, shake it or anything to move the more loosely arranged aggregate so that they will fall into closer and more compact position.

Effect of Excess Water

The use of excess water impairs the strength, makes the concrete porous and causes the lighter material to float to the top and cover the surface with laitance and foreign material, which may have found its way into the mixture. In some concrete structures there is an advantage in having the best concrete at the bottom, but it is evident that the best concrete should be at the top of a road.

Engineers have long known that an excess amount of water used in mixing will cause a considerable loss of strength in the concrete. Exactly what ratio exists between water content and strength has recently been shown by the extensive investigations of Professor D. A. Abrams of Lewis Institute, Chicago. The accompanying curve gives the results of his experiments.

The use of too much water cannot be blamed unreservedly on the contractor because heretofore methods had not been developed for the practical use of stiff concrete for roads.

Use of Fine Aggregate

The size of the aggregate governs largely the amount of water needed to give a workable concrete. The smaller aggregate requires more water.

If a road were built of a rich mixture of cement and fine aggregate, the cost would be excessive and the expansion and contraction would be greater than if a mixture of fine and coarse aggregate had been used. Moreover, when a contraction crack forms in a concrete road, the coarse aggregate dovetails the slabs together, holding them in their original relative positions.

The greater the proportion of good, clean stone, mixed in a given consistency of cement mortar without forming voids, the better the concrete will be for roads.

Mechanical Compacting of Concrete

While concrete used for building roads presents more than the ordinary disadvantages to the use of excess water or fine aggregate, it offers exceptional opportunities for mechanical compacting on account of its accessibility.

The method of applying force in mechanical compacting must be such that the larger pieces will not be displaced after they have settled to their best relative positions. The applied force must not drive a stone past the best place for that stone to stop, and the only available means for stopping that stone at the right place is the increased resistance offered to the movement of the stone by a more compact mass than the mass in, and with which the stone is moving.

Assume that we have an agitating force with a limited violence or a tamper with a given stroke. A greater frequency of strokes enables us to make a stiffer concrete flow.

It is this principle—the rapidity of agitation—which yields the unique advantage that mechanical tamping has over hand work.

Under a rapid succession of strokes, the concrete literally flows as a result of the agitation and the mass is in a semi-liquid condition. The drier and coarser the concrete, the less it will move under the influence of a single stroke, and the sooner it will be at rest again. To obtain the advantages of a moving friction, the succeeding stroke must come while the concrete is still in motion.

Voids in concrete are a source of weakness and, if beneath the surface, may not be detected until the ravelling of the aggregate under traffic exposes them. Therefore, the effect of the agitation must be in all directions and the agitation must be

VIEWS ILLUSTRATING THE MACHINE FINISHING OF CONCRETE ROADS.

Top: Machine Superior to Hand Methods in Producing Uniform Pavement Body and Surface—Center: Machine Spreads, Tamps and Finishes Concrete, Striking Ten Times in its Own Width—Bottom: Concrete of this Consistency makes the Strongest Road but is very Difficult to Strike and Finish by Hand. The Machine Handles it Easily.

continued and repeated until there is a reasonable certainty that the desired result has been accomplished.

Starting with these ideas, the writer developed the concrete road finishing machine shown here.

Concrete Road Finishing Machine

After numerous experiments it was found to be exceptionally advantageous to utilize suction for the purpose of agitating the concrete mass.

If the concrete in walls, for example, be agitated, it will be noticed that the concrete near the surface is easily shaken into shape, while it is difficult to produce any movement in the bottom of a deep layer of concrete, on account of the weight of the concrete above. This is so obvious that it would seem to be unnecessary to direct attention to it. Any additional pressure in the direction of the force of gravity tends to bridge, arch or bind the aggregate in the positions assumed under the force of gravity instead of facilitating any movement in the mass that would rearrange the aggregate into more compact positions. A keystone of an arch is not displayed by downward pressure upon it.

It was found that by creating a vacuum above the concrete mass in one place, mortar was forced towards the vacuum space, disrupting the binding of the aggregate, and permitting

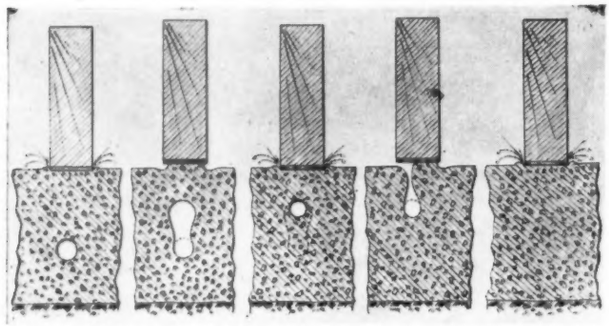


DIAGRAM ILLUSTRATING HOW ENTRAPPED AIR IS REMOVED FROM GREEN CONCRETE BY ALTERNATING PRESSURE.

Left to Right: 1, Air Compressed. 2, Air Expanded in Path of Least Resistance. 3, Air Bubble Again Compressed Nearer Surface. 4, Air Bubble Breaking Through Surface. 5, Air Bubble Entirely Removed.

the pieces to settle into more compact positions—hitting the keystone from the bottom, so to speak. The idea can be well illustrated by a log jam. Force applied to the up-stream side of the jam only wedges the mass more firmly; it would be readily broken by pressure applied below the jam by a reversal of the current.

In the machine illustrated, the suction is obtained by the tamper templet, which is raised with a jerk after hitting the concrete—alternately driving the concrete away and jerking it back. This action removes the entrapped air, giving a dense concrete.

The machine illustrated is so constructed that the speed, length and intensity of the strokes can be varied at the will of the operator to meet all the different consistencies of concrete and conditions found in road work.

A laborer tamping concrete, would pass over the surface if it appeared finished. The machine tamps thoroughly and uniformly. As it works forward and backward, it attacks a bad arrangement of aggregate, first from one direction and then from the other, insuring a slab of uniform density.

Besides the advantage of more thoroughly and uniformly compacted concrete, machine finishing is a more dependable means of obtaining a true, even surface—thereby reducing the vibration and wear on the pavement and vehicles.

Acknowledgement

The foregoing paper was presented as a part of the Short Course in Highway Engineering, given at the University of Illinois, Urbana, Feb. 18, 1919.

Sterilization of Water and Sewage

An attractively printed bulletin is being distributed to illustrate a few of the many contributions of the technical staff of the Wallace & Tiernan Co., Inc. (349 Broadway, New York) to winning the war. Among the most interesting achievements of this staff was the conception, design and construction of large fleets of water pumping, purification and laboratory trucks. These units were always ready for action and accompanied our troops to supply absolutely pure water from grossly polluted streams. Liquid chlorine and W. & T. apparatus were used to sterilize all the water pumped as it is recognized that no water is safe until it is sterilized. In domestic water supply sterilization, it should be noted, water-borne diseases can be absolutely eliminated at a cost of less than 50 cents per 1,000,000 gals. The W. & T. booklet "Why" gives the reason for sterilizing water and sewage.

The Dry Feeding of Chemicals Used in Water Purification

By F. B. Leopold, Vice President, Pittsburgh Filter Manufacturing Co., Farmers' Bank Bldg., Pittsburgh, Pa.

In the design and operation of filtration plants one of the most important features is the method of applying the coagulant to the water to be treated.

Former Practice

Since the inception of mechanical filtration, the making of solutions and the application of the solutions to the water has been the generally accepted plan of treatment. The use of solutions has always been attended with more or less difficulty, due primarily to the fact that in order to avoid the extreme cost of large solution tanks that would be necessary to make up dilute solutions, the practice has been to use solutions of considerable strength and in consequence of a highly corrosive nature, with a consequent rapid deterioration of all materials which it came in contact with. Pumps were used largely in the earlier days, to pump the solutions from tanks that were located below the floor line of the building, in order to avoid taking up valuable and costly space in building construction.

Present Practice

However, the cost of maintenance of pumping apparatus and piping connections proving so excessive, the latter-day practice has been the elevation of solution tanks into upper parts of the building and then feeding by gravity through constant head orifice tanks, using as short line connections as possible to reduce to the minimum the depreciation cost.

This, however, has meant a very considerable increase in the cost of building construction, due to the necessary supports of tanks and the considerable space occupied by the solution tanks. It has been recognized for many years that a satisfactory method of measuring and feeding pulverized materials that would avoid the use of solution tanks, and simplify and reduce the quantity of piping necessary, was the ultimate ideal solution of this vexatious question.

A number of different devices have from time to time been used with more or less success, but there has, so far, evidently been lacking some essential detail necessary to their successful operation and extensive use.

Dry-Feed Process at St. Louis, Mo.

The city of St. Louis has been using a dry-feed process for a considerable number of years. The apparatus, however, is an extremely elaborate and expensive proposition, beyond the reach of most large plants and utterly out of consideration for the average plant.

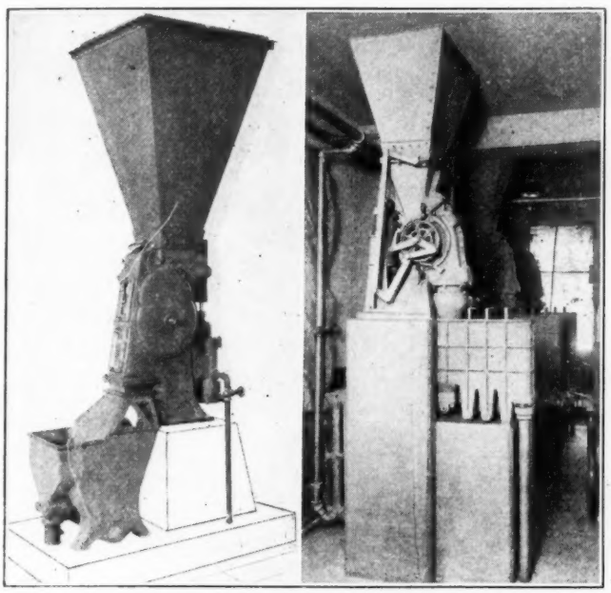
A New Machine Developed for Dry Feeding

The Pittsburgh Filter Manufacturing Company has been experimenting with a number of different devices and designs and have finally developed a machine that will meet the popular need and be low enough in cost to come into general use. This machine, after being constructed, was given a consider-

able test in the shop, and one of the machines was then placed in operation in the city of Toledo filtration plant, where it has been operating continuously day and night for over two and one-half years. It has required practically no attention and has given no serious difficulty, while the results in the treatment of the water, or the application of the chemicals, has shown a more uniform treatment than by the old solution method originally used. Since then these machines have been installed for the use of pulverized alum, iron, soda ash and lime, with most gratifying results.

Dry Feeding in the Great Falls, Mont., Plant

In the construction of the 12,000,000-gal. plant at Great Falls, Mont., solution tanks were entirely omitted from the design, and the chemical feed provided for entirely by the installation of three of these dry-feed machines, set in a battery.



DRY FEED APPARATUS FOR WATER PURIFICATION PLANTS.

Left: Latest Design Machine Showing All Parts Enclosed; Glass Observation Doors; Dust Proof. Right: Battery of Dry Feed Machines in Service at Great Falls, Mont., Water Purification Plant.

These three machines with their hoppers occupy about one-half of the space that would have been required for one solution tank, while in order to provide for continuous feeding of solution two solution tanks would have been required for each chemical used. The saving, therefore, in the construction cost at this plant has paid for the dry-feed installation several times over in the initial cost.

Dry Feeding at Flint, Mich.

The city of Flint, Mich., increased the capacity of their filtration plant from 8 to 16,000,000 gals. per day, abandoned the solution tanks and installed this system of dry feeding of chemicals. By the system to be installed there the pulverized chemicals will be unloaded into bins located over the dry-feed machines, and after the one handling of the material from the car to the bin the entire operation is by gravity into the daily hopper of the machine and from there to the solution mixing chambers. In addition to the economy in installation there is the added economy in the operation due to the single handling of the material that cannot be avoided where solutions are necessary to be made in the ordinary way.

Description of the Machine

The machine is simple in form, readily accessible in all parts, comparatively little to wear, and that easily replaceable. It is subject to a wide variation in range of feeding. The machine illustrated has a range of from 150 lbs. per 24 hours up to 15,000 lbs. per 24 hours. It is an accurate feed through all stages of this range.

It consists of a main cast iron housing, into which is fitted a roughened drum wheel, upon which the material rests and which carries the material forward through an adjustable orifice. The degree of opening and therefore the rate of feed is indicated by a pointer on one side of the frame of the machine. This feed wheel is operated by a ratchet wheel attached to the same shaft and on the outside of the framework. The ratchet in turn is operated by a motor.

Adjusting the Feed

There are three means of adjusting the feed to the required amount. First, by the orifice opening; second, by the adjustment of the ratchet to the number of teeth that the pawl engages at each stroke; third, by the speed of the motor. This gives an extremely wide range of adjustment. One side of the machine is open, or rather is covered by a cover plate, which, when removed, allows the removal of all the internal working parts of the machine, without the necessity of taking it apart or from its location. Each machine is operated by an absolute displacement piston motor mounted on the same frame with the machine. This motor may be arranged to operate at any given number of strokes per minute that is desired, and by the use of proper controlling device in conjunction with the Venturi tube can be arranged to operate proportionately to the flow of water that it is desired to treat. With each machine is furnished a cast iron mixing box or chamber, into which the dry material is discharged. This is a cast iron box with removable baffles, to enable the convenient cleaning of any sediment that may accumulate in the bottom.

Regulating Strength of Solution

Water for dissolving is introduced into a mixing chamber immediately below the point at which the dry material is discharged into the mixing chamber, and can be introduced in any quantity or portion desired. In other words, the solution may be made as weak as desirable to avoid the corrosive action of the solution on the piping system used to carry the solution to the final entrance to the water to be treated.

By this arrangement materials can be used for this work that, with the ordinary strength of solution necessary when solution tanks are employed, would be impossible by reason of the corrosive action.

This system of feeding dry chemicals is now in use at Great Falls, Mont., Grand Forks, N. D., Fort Madison, Ia., Tulsa, Okla., Spartanburg, S. C., and Toledo, O., filtration plants, and has been contracted for in many other cities in plants varying from 1,000,000 to 10,000,000 gals. capacity. With the test of time proving out the expectations of the manufacturer, they should work a revolution in this feature of the design of filtration plants and will undoubtedly result in many of the present plants being changed from solution to dry feed.

The present type of machine is designed for plants varying from 4,000,000 to 5,000,000 gals. up to approximately 25,000,000 or 30,000.000 gals., or even larger.

Design Features of Sewage Disposal Plant at Industrial Housing Development of the Alan Wood Iron and Steel Co., at Swedeland, Pa.

By George L. Robinson, Consulting Engineer, 37-39 E. 28th Street, New York, N. Y.

From the plans of Messrs. Savery and Scheetz, Architects, of Philadelphia, the Alan Wood Iron and Steel Co., have built up a most attractive industrial housing development which at present has some hundred substantial brick houses for the superintendents, foremen and workmen at Swedeland, Pennsylvania.

The location of the village on the Schuylkill river made it necessary to provide an adequate sewage disposal plant to treat the domestic sewage produced by the community.

Sewage Collection

The village is located on a hillside well above the river and the sewer lines are planned of such sizes and grades that

they may take not only the domestic sewage from the population about to occupy the development, but may be added to from time to time as the village growth may warrant. It is supposed that the maximum future growth of the village will not produce more than 250,000 gals. per day; that is, perhaps 500 houses with 5 persons to the house.

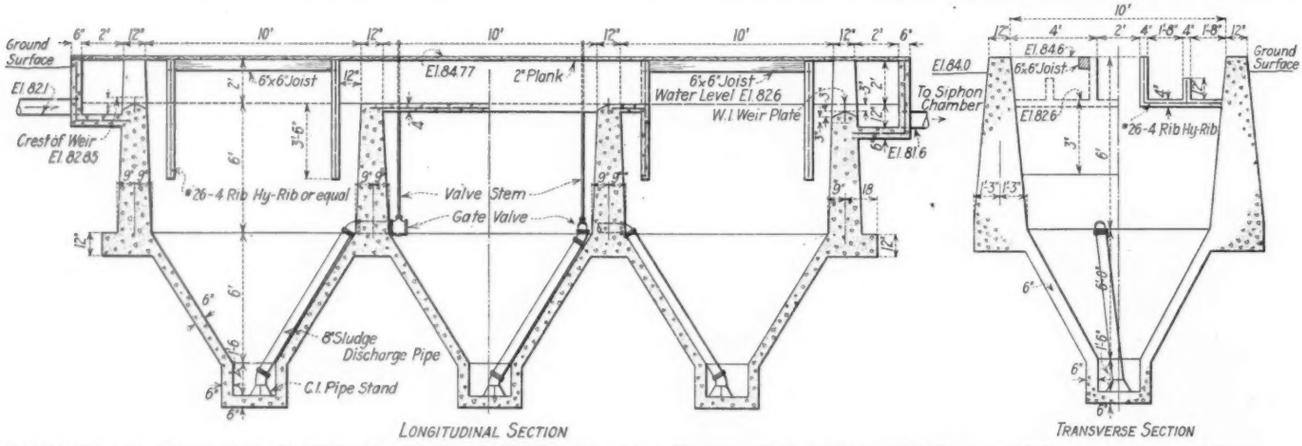
Sewage Disposal

The disposal plant is designed to receive the domestic sewage from 100 houses with an estimated population of 5 persons in each house. An allowance of 100 gals. per person per 24 hours, or 50,000 gals. per 24 hours, is taken as the basis of the design.

Elements of the Disposal Plant

(1) A screen chamber to remove such very heavy matter as might pass through the sewer, and which it would be undesirable to have enter the settling tank. Provision is made for future enlargement and extension if the growth of the village warrants it.

(2) A settling tank which is planned along the lines recommended by the United States Housing Corporation, of which John W. Alvord is chief engineer.



SECTIONS OF SETTLING TANKS OF SEWAGE DISPOSAL PLANT OF THE ALAN WOOD & STEEL CO., AT SWEDELAND, PA.

The structure is made up of three bays or hopper tanks, the details of which are shown herewith. The sewage enters the first compartment, and, after passing under the baffle walls, passes out through troughs over the second (or sludge) tank into the third (or second settling) compartment, thence to the siphon dosing chamber beyond.

The arrangement of this group of hoppers permits double settling and the withdrawal of sludge from time to time to the sludge digestion bay or hopper. This plan obviates the gas chambers and self-contained sludge digestion chambers used in the Imhoff tanks.

The sludge pipe arrangement, valves, troughs, baffles, etc., are all plainly shown and the scheme of operation is self-evident.

The Alan Wood Iron and Steel Company will bring to the site of the disposal plant a water line and provide a fire hydrant so that water jet through hose and nozzle may be used in flushing sludge or floating mat from settling tank into digestion hopper, or in starting flow to sludge bed, or for the purpose of introducing fresh water with its oxygen content into either the settling tank or the digestion hopper.

(3) The siphon chamber provides for a dose of about 1,000 gals. This will take up the maximum flow and permit the spraying on the bed beyond at a rate of about once every 18 minutes maximum and about once every hour minimum. There will be an 8-in. Miller siphon with a maximum head on the filter of 6 ft.

(4) The sprinkling filter receives the water from the siphon chamber. This bed offers an area of 1,755 sq. ft., or a little more than .04 of an acre. This is a sprinkling rate of 1,250,000 gals. per acre per day, with a filtering depth of stone of 5½ ft.

The sprinklers will be Taylor "hexagonal," fed from cast iron 4-in. distribution pipes and 3-in. cast iron risers.

The stone or slag (2-in. to 3-in.) filter material will be underdrained by 12-in. vitrified half-pipe. The filter material will be supported by a 6-in. concrete floor, sloping for drainage; concrete walls at the sides.

(5) The sterilizing outfit consists of a brick house to contain a Wallace & Tiernan Company's chlorinating apparatus, and a concrete chamber, in which the chlorine will be liberated from a submerged diffuser.

From this unit the sterilized effluent will pass through a 10-in. vitrified sewer to a culvert under the tracks and thence to the river.

(6) The sludge beds provide a surface area of 1,540 sq. ft., or 770 sq. ft. each side of the partition plank. It is not intended to draw more than 400 cu. ft. of sludge at one time. The underdrains from the sludge bed pass to the sterilizing outfit, so that the filtered sludge water will be treated before it reaches the river.

It is proposed to add additional units to the plant as the population increases, so that the rate of settlement and filtration may be maintained within proper limits.

Equipment and Methods Employed in Building Sewers in San Francisco, Calif.

By H. W. Shimer, Assistant City Engineer, San Francisco, Calif.

San Francisco, being situated on the tidewater, has a comparatively simple sewage disposal problem. In the early days of the city the sewers were discharged into the bay at the most convenient points. As the city grew, the sewage increased in quantity and became a nuisance in certain places along the water front. In some sections of the city the old sewers were inadequate. This led to the adoption of a general plan of constructing interceptors, reconstructing sewers that were inadequate, and the construction of storm water relief sewers. This work has been under way for about 15 years and has not as yet been completed.

The disposal scheme adopted is to discharge the sewage only at points where there are strong tidal currents. Overflow structures and relief sewers discharging into the bay at convenient points are provided to take care of the storm water.

A great deal of this work has been done on busy streets, all of it involved handling the flow of existing sewers, and some of it was tide work.

Another feature of the sewer construction is the building of sewers to serve new districts. These, however, are usually in the open country or sparsely settled districts and are located

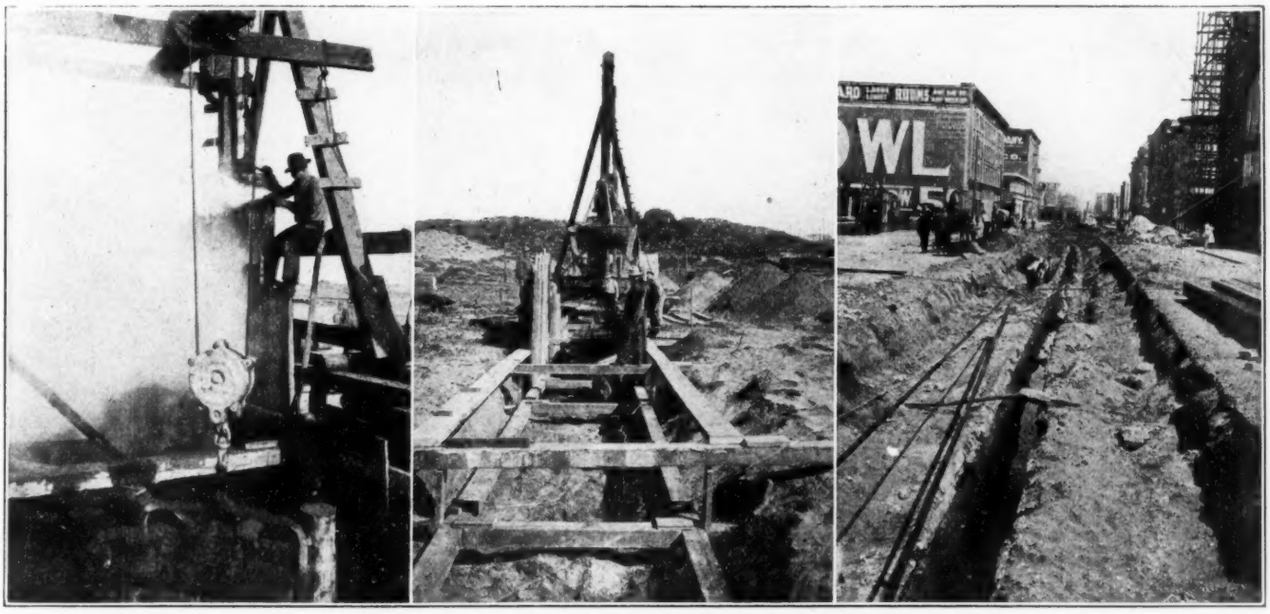
on hillsides, where there are no flat grades and where there are no existing sewers to deal with.

This work has been divided into small sections and let by contract. The largest contract only involved $223,000, while the work thus far completed has cost well over $6,000,000. With so many contractors there has been a great variety of methods and equipment. The writer will only attempt to describe the methods and equipment that experience has shown to be the best.

Pipe Sewers

A description of the equipment and methods used in the construction of sewers in San Francisco can best be done by dealing with pipe sewers and concrete sewers separately. The pipe sewers are easy to construct. The excavation is comparatively light, and the methods are accordingly simple.

The equipment seldom consists of more than some lumber for lagging and some picks and shovels, and even the picks are not required in sand. Concrete sewers require much more elaborate methods, and sometimes considerable equipment. The construction of brick sewers has been discontinued in this city.



VIEWS ON SEWER CONSTRUCTION IN SAN FRANCISCO.
Driving Sheeting with Steam Hammer Excavating Bucket in Foreground—Derrick Equipped with an Orange Peel Bucket, Lagging Started and being Driven by Hand—Removing 3x5 ft. Brick Sewer and Old Cable Railroad Slots to Make Way for an 8 ft. Sewer.

The pipe sewers are made of vitrified, salt-glazed ironstone pipe, varying in size from 8-in. to 24-in. The 8-in. to 12-in. is single strength and the 15-in. to 24-in. is double strength. The joints are made with 1:1 cement mortar. A gasket of hemp dipped in cement grout is inserted in the joint of the double-strength pipe before the mortar is put in. This holds the pipe in line and prevents the mortar from being pushed through into the pipe.

Trenching

The pipe sewers are about 10 ft. deep and the excavation is usually done by hand. Conditions are favorable for the use of trenching machines only in a few instances. A great many of the jobs are in loose sand, and others are in streets where there are many obstructions.

However, trenching machines have been used in a few cases.

Sewers of this class are constructed in districts where there is no objection to storing the excavated material in the street.

Method of Timbering

The method of timbering used consists of digging holes with a post auger and setting 4x4-in. posts long enough to reach a few inches below the bottom of the trench. These posts are placed in pairs, one on either side of the trench, and 8 ft. apart along the trench. As the excavation is carried down, 2-in. planks are inserted behind the posts and the dirt carefully packed behind them and braces are placed between the posts as needed.

Pipe Laying

Pipe laying follows as close behind the excavation as possible. The pipe-laying crew usually consists of four men, two in the trench and two on top. Of the two men in the trench, one prepares the trench for the pipe and the other makes the joints. The two work together in laying the pipe. The pipe is lowered into the trench with a rope by the two men on the surface, who also mix the mortar and handle the plumbbob and grade stick.

Backfilling

The backfilling is usually done by hand. The first foot is hand tamped. The remainder is hand tamped or flooded with water, depending upon the character of the soil. The lagging is removed as backfilling proceeds. In a few special cases where the ground was very wet or treacherous, or the trench was of unusual depth, some of the methods of excavation or timbering used on concrete sewers have been adopted.

Concrete Sewers

The standard sizes and shapes of concrete sewers built in San Francisco are 2x3 ft. and 2 ft. 6 ins. x 3 ft. 9 ins., which are egg shape, but with a slab top, instead of an arch; 3 ft. x 4 ft. 6 ins. and up to 4 ft. x 6 ft., which are of the standard egg shape, and circular sewers with diameters from 3 ft. to 9 ft. Various odd shapes and sizes have been built to meet unusual conditions.

The depth of excavation varies from practically nothing where the sewer follows a creek bottom to cuts of 25 or 30 ft. The materials encountered are rock, clay, sandy clay, loose sand and very wet sand.

Excavation

The excavation of the shallower trenches is done by hand. The deeper trenches are usually excavated by a derrick equipped with orange peel, clam shell or dump buckets. These derricks are of the stiff-leg variety, and are usually mounted on a platform spanning the trench. The platform is mounted on rollers, which enables it to be easily moved as the excava-

tion progresses. The derrick is equipped with a two-drum donkey engine and an auxiliary swinging engine. Fuel oil is usually used under the boiler. The crew consists of an engineer and a signal man and sometimes a fireman.

Rock excavation is neither hard enough nor extensive enough to warrant the installation of air drills. When blasting is necessary, drilling is done by hand. The explosive is 40 percent dynamite and black powder.

Trenching machines have been used on a few jobs, but conditions are usually such that their use is impracticable. Steam shovels have been used to a very limited extent to take out the main body of excavation.

The excavated material is stored along the side of the trench except on busy streets, or where it would interfere with traffic. Here the city requires the material to be removed as fast as excavated.

Timbering

The only timbering used in rock, clay and sandy clay is an occasional timber brace to guard against slips. In loose or wet materials, vertical timber sheeting is used with timber walings and braces. The sheeting is 2x8-in. or 3x8-in. planks and, if the ground is very wet sand, they are tongued and grooved. They are driven with wooden mauls or small steam hammers. The steam hammer is suspended from a wooden frame with a chain block. The frame is so constructed that the hammer can be moved easily from one plank to another. When it is necessary to move the frame, it is done by the derrick. The steam is furnished by the boiler on the derrick. The sheeting is driven about 3 ft. at a time and proceeds with the excavation. After the backfilling is completed, the sheeting is usually pulled by hand with a lever about 12 or 14 ft. long. A clamp is used that tightens by pulling sidewise. If a derrick is used for backfilling, the sheeting is pulled by it.

Supporting Sewers on Piles

Old marshes and swamps that have been filled in are continually subsiding. To keep a sewer to line and grade it is necessary to support it on piles. These piles are sometimes driven before the trench is excavated, but usually afterwards.

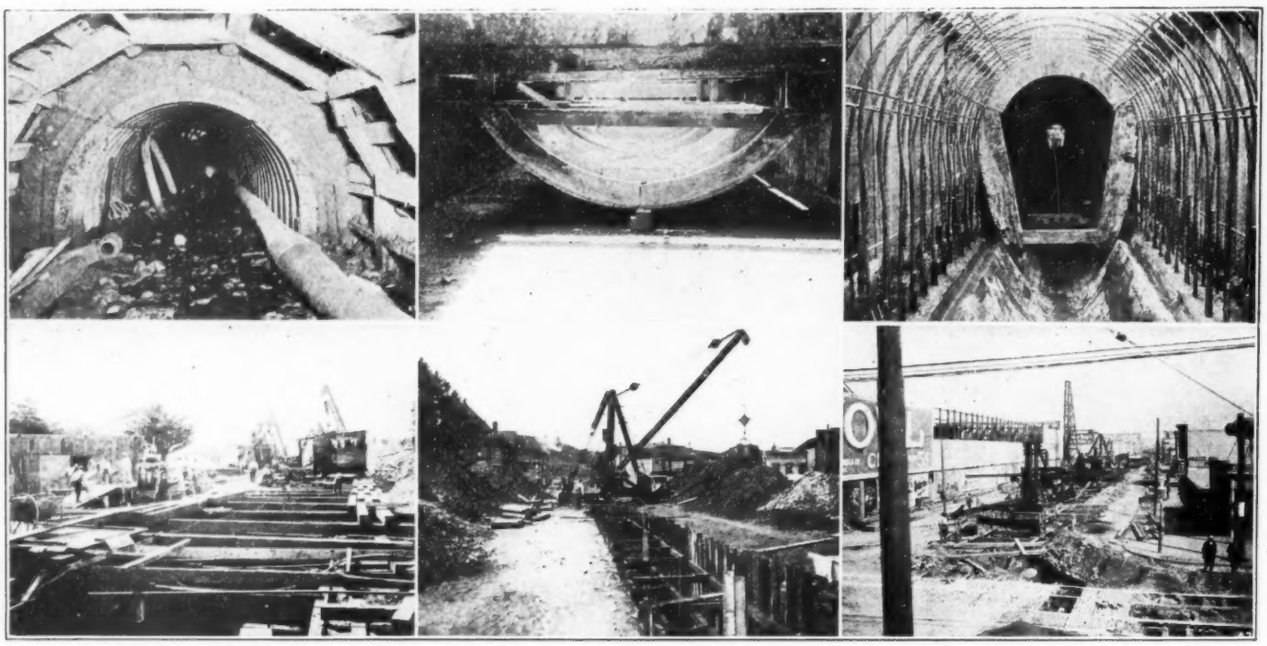
The pile drivers are mounted on skids, and are supported on greased sills spanning the trench. They are equipped with a two-drum oil-burning donkey engine. An effort is made to use a driver tall enough to handle easily the longest pile required up to 60 or 70 ft. If piles longer than 60 ft. are required, splicing is permitted. The type of splice found to be most satisfactory consists of a dowel about 4 ft. long and a piece of steel casing about 2½ or 3 ft. long, and just large enough to fit the smaller pile end.

Most of the pile drivers are equipped with No. 1 Vulcan steam hammers. The other hammers used are the No. 2 Vulcan and a 3,000-lb. drop hammer. The material through which piles are driven is mud and sand, and the No. 1 Vulcan gives the best results.

The piles are driven to within a foot of subgrade when possible.

Underdrains

If running water is encountered in the trench, an underdrain is used, consisting of vitrified bell and spigot pipe surrounded with crushed rock. The bottom of the trench is covered with crushed rock to give a clean, dry surface on which to pour concrete. The joints of the pipe are caulked with oakum, leaving a small opening on the top to admit a small quantity of water. It is desirable to take as much of the water into the open end of the pipe as possible. If the pipe could be laid with tight joints, no water would be taken from under completed work.



MISCELLANEOUS VIEWS ON SEWER CONSTRUCTION IN SAN FRANCISCO.

Top Row: Mile Rock Tunnel, Showing Timbering, Completed Concrete, Forms, Ventilating Pipe and Delivery Pipe from Pneumatic Concrete Mixer-Sewer Invert Form in Place—4x6 ft. Sewer Showing Invert with Vitrified Brick Lining, Steel and Forms. Bottom Row: Some of the Equipment used on a 9x11 ft. Sewer—Derrick with Bucket in Soft Rock —Equipment used on an 8 ft. Circular Sewer Built on Piles.

Considerable skill is required to keep an underdrain open, and running for any considerable distance in sand bearing large quantities of water. Sometimes a rope is carried along inside the pipe to assist in freeing the pipe of sand. A hose with water under pressure is sometimes resorted to. Tees projecting up through the invert are put in from 100 to 300 ft. apart. These are very useful in keeping the drain open and also in plugging it after the sewer is completed. The plugging is done by flushing in as much sand as possible, and then putting concrete plugs in all the tees.

The underdrains are led in sumps usually just outside the trench but occasionally in the bottom of the trench. Great precautions are necessary to have the sumps tight so that no sand can get into them from under the sewer.

Centrifugal pumps electrically driven are generally used.

If the quantity of water is not great, and the condition of the trench is such that no particular damage will be done if the pump goes out of commission, an automatic control is often used.

Invert Construction

As soon as the underdrain is laid the reinforcing steel is placed if any is required and the invert forms are set. Forms for the invert give much more satisfactory results than a template and straight edge, and also save considerable plastering or chipping. The forms are of wood and 8 ft. long. They are supported and braced from the trench braces, and walings. The forms are removed the next morning after the concrete is poured and a lining of vitrified brick constructed. As soon as the mortar has thoroughly set, the reinforcing steel is placed, and the top and side forms are set. These forms are also made of wood, and are usually 8 ft. long. They are built in two or three pieces. The two piece forms are somewhat easier to set, but the three piece forms can be removed and carried through other forms that have been recently set.

Concreting

The concrete proportions are 1:2¼:5 and the materials are Portland cement, sand and crushed rock or gravel. The sand and rock are piled along side of the trench as conveniently as possible. Where the material can be piled continuously along close to the trench, the mixer is located on the edge of the trench and the concrete is conveyed directly from the mixer into the forms through chutes and the machine is moved as often as necessary. Where the rock and sand can not be stored close to the trench or only at intervals several hundred feet apart the mixer is installed close to the materials, and the concrete is transported in buggies to the chutes. One interesting installation was a mixer installed on a platform that spanned the trench. The materials were wheeled up runways that were a part of the platform. The concrete was deposited through short chutes. The platform was moved by the donkey engine of a nearby derrick.

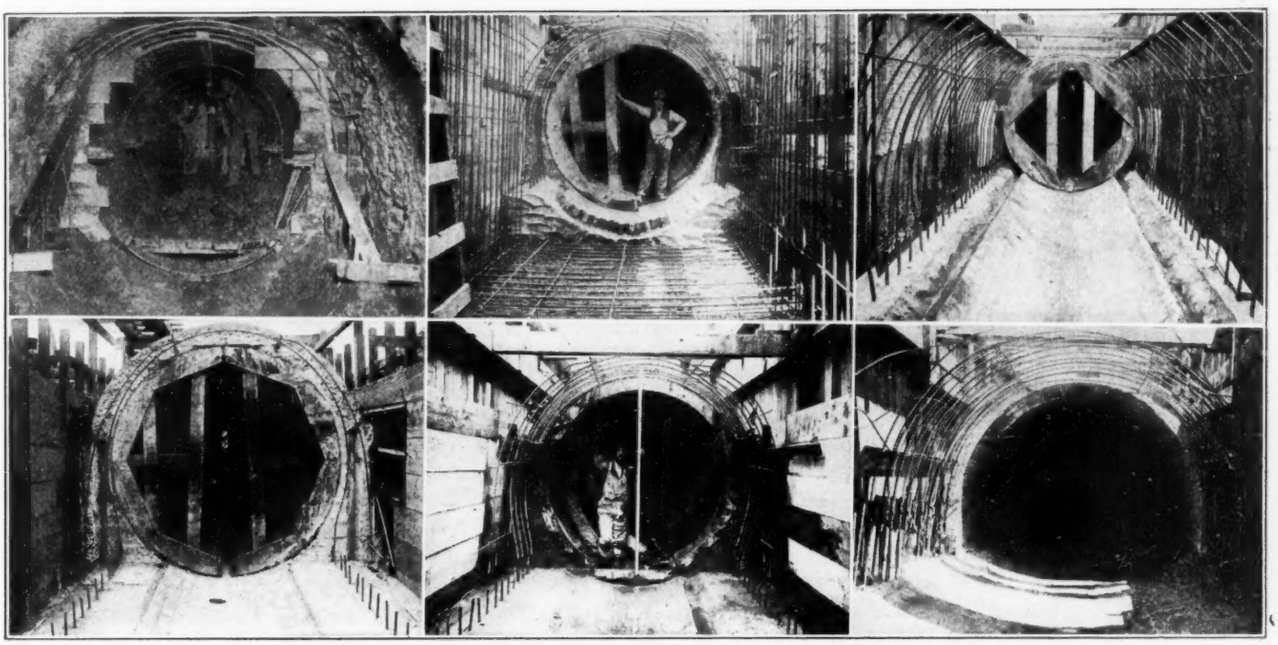
The power used is generally a gasoline engine but sometimes steam is used or electricity if power wires are handy.

Backfilling Concrete Sewer Trenches

The backfilling is done by hand, with Mormon scrapers, or with clamshell buckets operated by a derrick depending upon the kind of material and whether or not the backfill must be compacted. If this trench is to be paved over, the backfill is compacted by hand tamping or flooding with water.

Tunnels

Within the last ten years, six tunnels have been dug in connection with sewer building. All but one of the tunnels have been in rock of varying degrees of hardness. The varying degrees of hardness sometimes occur very close together on the same job. For this reason it is often impossible to prevent large overbreak. The excavation proceeded in the manner customary in small tunnels. In the smaller tunnels the drilling was done by hand and the muck was hauled out by hand. In the larger tunnels compressed air drills were used and the muck was hauled out with mules. Various methods of concreting have been used. The usual method has been to have the mixer located near the portal or a shaft. The concrete was conveyed by chutes to cars in the tunnel. These cars were dumped either directly into the forms or into boxes, and the concrete shoveled into the forms. The sheathing of the forms was built up as the concreting progressed.



VIEWS ON SEWER CONSTRUCTION IN SAN FRANCISCO, CALIF.

Top Row: Hunter Point 6 ft. Circular Sewer, Shoveling Concrete into Forms—Circular Sewer, 8 ft. 6 in. Diameter—8 ft. 6 in. Circular Sewer Showing Invert with Brick Lining and Forms and Steel in Place for Sides and Top. Bottom Row: 8 ft. 6 in. Circular Sewer with Forms in Place—8 ft. Circular Sewer Showing 3-Piece Forms in Place with Others Inside—9x11 ft. Horseshoe Sewer.

Pneumatic Concreting

In the last tunnel job a pneumatic mixer was used. With this process the forms are completely set up before the concreting starts. The end of the concrete discharge pipe is placed in the forms, the concreting then proceeds until the forms are filled without any interruption to the tunnel excavation. The force of the concrete insures that all the holes and cracks will be filled. The crew consists of a foreman, three men at the mixer and one or two tampers. The concrete is of excellent quality and the method has proven highly satisfactory.

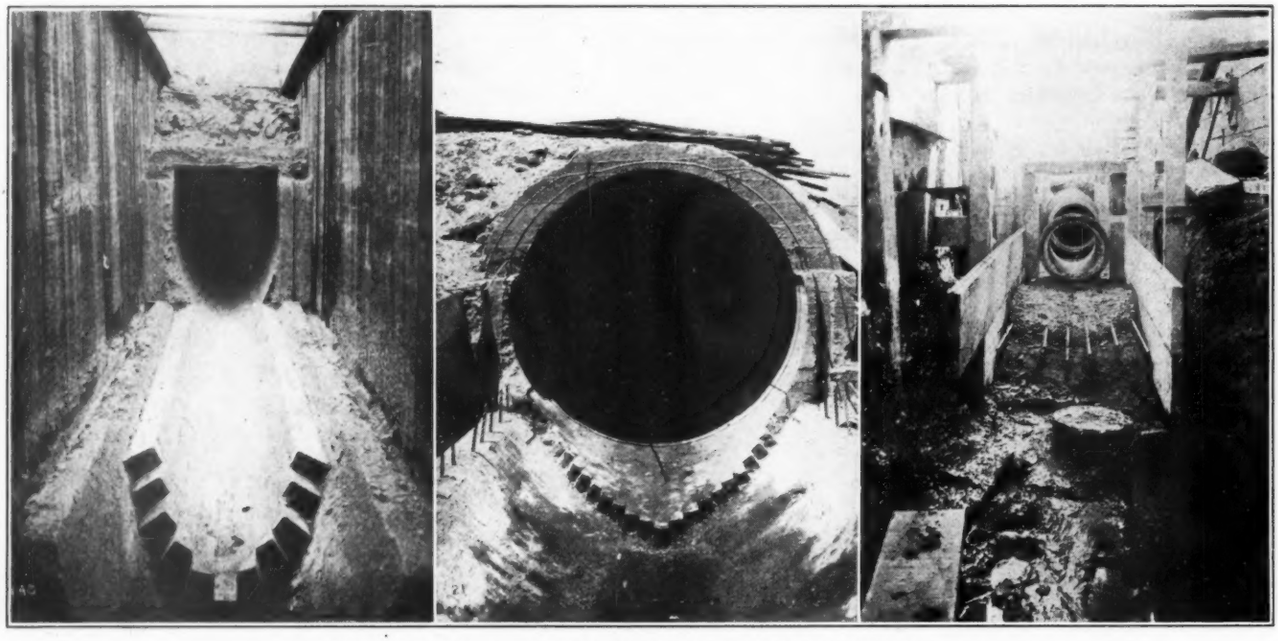
Particular attention has been paid to getting all overbreak and spaces around timbers entirely filled. This has been done in a number of ways. One inch sheathing has been nailed to the inside of the timber sets and all spaces filled with sand. Considerable quantities of rock have been used with concrete in the overbreak.

The most satisfactory method was to fill the large overbreak with rough masonry composed of rock taken from the tunnel and lean cement mortar, depending on the concrete to fill the smaller spaces.

All the sewage of San Francisco is discharged into San Francisco Bay. Most of the outfalls discharging at the elevation of low water require slightly different methods from the ordinary sewer construction. The outfall structure usually is built through the loose rock sea wall. A single row of sheeting suffices for the sides of a light cofferdam, but on account of the loose rock it is not possible to unwater the last foot or so of the trench even at low tide. The usual method is to concrete the invert at low tide depositing the concrete in the shallowest portion of the trench and continuing to pour concrete into concrete instead of into water. After the concreting is finished the water is allowed to rise with the tide. Care is taken that there is no wash of water on or through the concrete. When carefully done the concrete has been found to be of first class quality.

Two submerged outfalls required strong well built cofferdams that could be entirely unwatered.

All sewer work in San Francisco is done under the direction of M. M. O'Shaughnessy, city engineer.



VIEWS ON SEWER CONSTRUCTION IN SAN FRANCISCO.

2x3 ft. Concrete Sewer with Brick Lined Invert—5 ft. Circular Concrete Sewer with Brick Lined Invert—24 in. Vitrified Pipe Sewer Supported on Piles and Surrounded with Reinforced Concrete.

Military Roads as Constructed and Projected by the Construction Division, War Department, U. S. A., in 1918

By Daniel B. Goodsell, Highway Engineer, Construction Division, War Department, Washington, D. C.

The road work at the National Army, National Guard and other camps, terminals, storehouses, etc., has been prosecuted under most adverse conditions during the last 1½ years due to the necessity of immediate completion and the use of the most available material.

Materials of Construction

The National Army camps or cantonments are better provided with roads than the National Guard or tent camps. For both of these classes of camps gravel, chert, slag or shell was the material immediately available and largely used. For the quartermaster's warehouse and main heavy traffic roads concrete was used extensively. This material found its place at fire stations where apparatus is washed, opposite garages and incinerators, manure loading platforms and coal trestles and other places where a hard, impervious surface was a necessity and it has fully justified its use by good service.

Bituminous macadam or penetration method roads were quickly constructed, almost immediately available for use and have proved satisfactory in many of the camps even under hard usage.

The problem of maintenance under war conditions with all the different kinds of pavements has been a difficult matter, due to lack of material, labor and expert highway engineers.

The construction of concrete pavements during the winter of 1917-1918 was attended with some failures due to freezing and the desire to use such roads before they were fit. In the main, the results have been good, although considerable work was done during the severe winter.

During the early stages of construction of camps, the paving work was prosecuted by the general contractor in charge of the building of the entire camp. This method was altered later, the roads being contracted for separately on a cost plus basis on account of the need for expert supervision, the large amount of work involved, and to secure expedition.

Cost Plus Contracts Commended

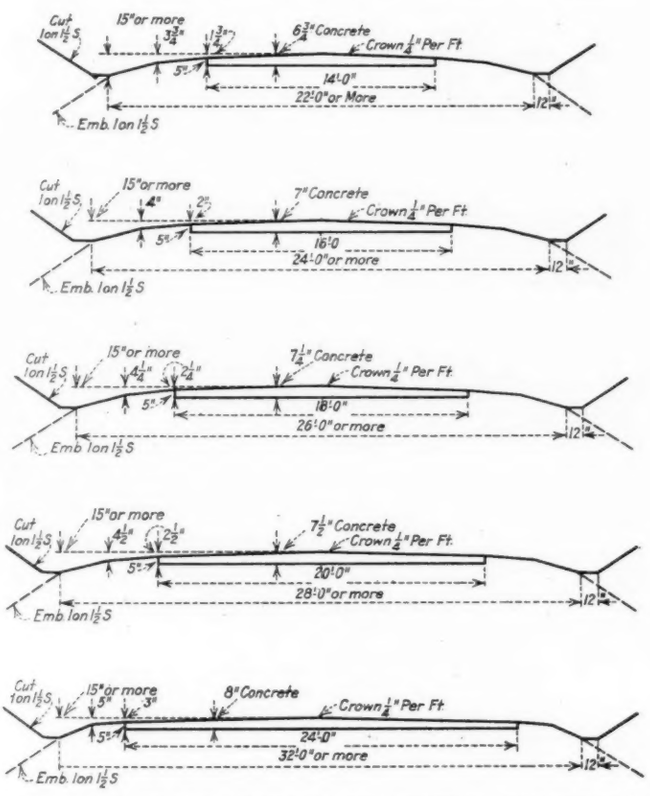
The cost plus type of contract has proved its worth in road work as in other construction. It enabled the contractor to do his work quickly and with a limited amount of friction. Brigadier General Marshall, Chief of Construction Division of the War Department, in commenting on the system before the Association of General Contractors of America, stated: "The great lesson of this war on the subject of the relationship between the contractor and the owner is the cost-plus contract. This represents the only equitable basis upon which a contractor may perform constructive and economic services for the owner. It is the only form of contract which affords protection to both parties. All of the energies, the thought and the experience of this country within its own continental lines during the past year and one-half of this world struggle shall have been in vain unless out of it shall grow, as a permanent institution, solidifying the economic relationship between the contractor and the owner, the cost-plus contract." Also before the American Society of Civil Engineers—"They have saved—and this is demonstrable—to the Government a vast amount of money. They have operated with smoothness, flexibility and with surprisingly little misunderstanding or friction between the Government and the many contractors in question. Without them the vast building program of the

Army which has been successfully accomplished would have been a matter of utter impossibility."

"The sole justification for the cost-plus contract as used during the war is not the uncertain and unstable condition brought about by the war, for the cost-plus contract, properly administered, is the proper conservative and just method of doing contracting work—just alike to the owner, the engineer and the contractor."

Costs

With more leisure at hand, projected road work at the cantonments, camps, posts, etc., will probably cost less. About 866 miles of road were constructed at a cost of about $21,000,000 by the Construction Division of the War Department



TYPICAL CROSS SECTIONS OF CEMENT CONCRETE PAVEMENTS BUILT BY CONSTRUCTION DIVISION, U. S. WAR DEPARTMENT IN 1918.

during the war period. Concrete roads cost from $30,000 to $65,000 per mile for widths of 13 ft. including grading and drainage, or an average of about $3.25 per sq. yd., with a more complete maintenance provided for and closer supervision a much lower ultimate cost is obtainable.

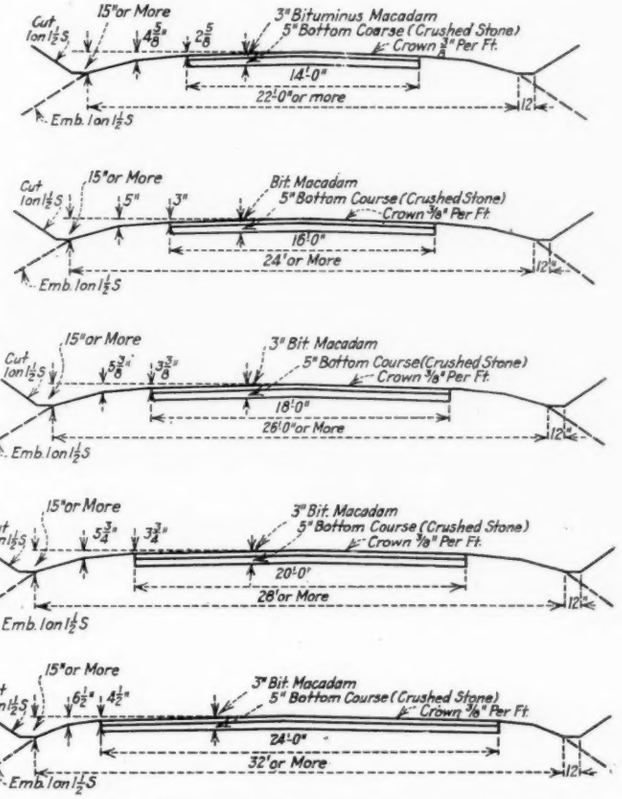
That the War Department should undertake the construction of those highways which connect in any one vicinity its military posts, warehouses, terminals or other utilities without regard as to whether such highways are on Government owned property or not is a question presented for consideration.

Many claims have been made for roads destroyed by army trucks during the war period. Much of this damage has been due to lack of maintenance. Prompt repairs, not possible at times, would have saved municipal and county authorities much money and would have formed the basis of a reasonable claim for reimbursement by the Government, in addition to aiding the war. Such cases were rare.

Abstracts From "Instruction to Constructing Quartermasters"

Principles of Design—Width

The width of roads should be governed by the number of lines of traffic and the speed at which it may be necessary to move them, more clearance being given for high speed, which is defined as above 15 miles per hour. The 5-ton truck used by the Army has over all dimensions of 7 ft. 6in.x21 ft. Trucks of these maximum dimensions require at least 2 ft. 6 ins. for clearance at a speed of 12 miles, which fixes the roadway for this kind of traffic at 20 ft.; where mule teams and light autos constitute a large percentage of the traffic and where the width of vehicles is not above 6 ft. 3 ins., a roadway of 18 ft. is sufficient. Less than this width should not be used unless traffic be light, slow moving, and the roadway constructed with substantial shoulders of bituminous or gravel macadam, the consideration being that any light traffic roadway may suddenly become heavy traffic, due to its use as a detour, or a change in camp conditions.



TYPICAL CROSS SECTIONS OF BITUMINOUS MACADAM PAVEMENTS (PENETRATION METHOD) AS BUILT BY CONSTRUCTION DIVISION, U. S. WAR DEPARTMENT, IN 1918.

Considerable difference of opinion has apparently existed among construction quartermasters as to the location and width needed for warehouse roads. A 5-ton truck requires, when backed up square to a warehouse platform, 33 ft. in which to turn. A maximum width of 42 ft. therefore is sufficient for backing and turning, the main road to be 24 ft. with wings of 18 ft. opposite the platforms. Manure loading platforms require a width sufficient for one line of traffic only as do the coal trestles and ordance storehouses.

Roads to trestles, incinerators and can-washing plants should be arranged in loops to afford continuous movement of traffic with ample loading space.

At all curves of less radius than 400 ft., the width of the pavement should be increased from 2 to 4 ft. and surface banked.

Thickness

Thickness of concrete pavement should be governed by (1) width, (2) the heaviest unit of traffic which will pass over it, and (3) subsoil conditions, such as whether the sub-grade is well compacted, subject to shrinkage, as is the case of trenches recently backfilled, or subject to washouts or the ground water not drained to low enough level. Limits of thickness

MILEAGE OF ROADS IN CAMPS, ETC., AS BUILT BY CONSTRUCTION DIVISION, WAR DEPARTMENT, AS OF JANUARY 1, 1919.

Types	National Army Camps	National Gard Camps	Miscell. Camps	Terminals	Regular Army Posts	Coast Art. & Miscell. Camps	Total
Cement concrete.	65.10	16.45	52.11	45.00	.....	....	158.66
Gravel	150.36	101.54	6.33	....	.....	....	258.25
Bit. macadam...	70.44	31.95	11.11	....	112.00	....	225.50
W. B. macadam.	38.43	15.24	49.37	20.00	200.00	32.30	355.34
Cinder and shell.	1.74	3.68	7.08	....	.....	....	12.50
Sand clay	4.83	20.71	.....	....	.....	....	25.54
Slag macadam...	0.28	.....	2.08	....	.....	....	2.36
Bit. concrete	....	.....	.....	....	.....	....	.....
Brick	0.95	.....	5.26	....	.....	....	6.21
Unpaved	53.62	83.51	18.51	....	.....	....	155.64
Total	385.75	273.08	131.87	65.00	312.00	32.30	1,200.00

for different widths of roads are shown on accompanying cross-section of roadway.

Type

Consideration should be given first of all to availability of material in selecting the kind of pavement with a view to avoiding as far as possible transportation of materials or machinery by rail for long distances. Secondly, the material must be selected to suit the traffic—concrete, brick, bituminous concrete, bituminous macadam and waterbound macadam or gravel or broken stone in the order named for the density of traffic estimated. For roads at the divisional warehouses, where much turning of vehicles occurs, concrete, brick or other hard surfaced pavement is to be preferred.

At incinerators and fire stations, etc., where vehicles are washed, or at manure loading platforms concrete or brick is to be preferred for sanitary reasons.

Grades

Topography is the limiting condition for grades, due to the fact that it should be the practice to avoid cuts of 3 ft. or more in the grading work. A deeper cut or fill may be justified, however, on the ground of avoiding a short steep grade of 4 percent or more, or a long grade of 5 percent or more in an artillery or balloon camp.

Alignment

Alignment at curves and intersections, where the view is obscured should be given attention, the road to be widened and banks or other obstructions cleared. The locating of roads close to barracks or kitchens so that there is insufficient room for road gutters and surface drainage, should be avoided and roads should be curved to fit the topography and avoid heavy cuts or fills, where such a location is possible.

Radius of curvature at corners should not be less than 15 ft.

Radius of main traffic roads should not be less than 200 ft. for speed of 15 miles per hour.

Drainage

The practice of constructing wearing surface prior to the contemplation of the drainage is not approved except under cases of extreme urgency. It is advised that a survey and plan be made showing the culverts, ditches, tile pipes, gratings, pipe drains or other drainage accessories and that this work of drainage be prosecuted far in advance of that of the wearing surface.

The construction of shoulders should proceed simultaneously with that of the wearing surface and they should be of road gravel, cinders or broken stones, if the wearing surface be of concrete or other hard material.

The work has been prosecuted under the direction of Major Leonard S. Doten, Q. M. C. up to July and since then under Major H. J. Philips, Q. M. C., as Advisory Engineer of roads to the Construction Division of the War Department.

New Model P. & H. Excavator With Side Wheel

A new model excavator with side wheel, here illustrated, has been added to the Pawling & Harnischfeger line. This machine was introduced to fill the want for an excavator able to dig close to curbing, pole lines, walls and to operate in other closely restricted quarters where a trench is to be dug.

This ditcher with standard side clearance cutters is designed to dig a trench 15 ins. wide to a maximum depth of 4 ft. Side clearance cutters can be furnished to enable the machine to dig to a maximum width of 24 ins. The machine is built of high-grade material throughout and the construction is first-class in every respect. All gears are made either of steel castings or forgings, and all high-speed gears have teeth cut from the solid. All chain sprockets are steel castings. All parts running on shafts are bronze bushed. The chains connecting the engine to the machinery and those driving the digging wheel are of steel of the roller type. Bearings carrying shafts of intermeshing gears are cast together wherever practicable in order to insure permanent alignment.

Corduroy grip tractions are provided for supporting the rear or heavy end of the machine. The machine is driven by a 25-h.p., 4-cylinder vertical engine of the tractor type, arranged for burning either kerosene, gasoline, or motor spirits. A tank is provided for gasoline and another larger tank for kerosene or motor spirits. The engine is water cooled. The

VIEW OF THE NEW SIDE WHEEL PAWLING & HARNISCHFEGER EXCAVATOR IN OPERATION.

operating levers are placed at the back of the car body and are so grouped that they can all be reached from one position.

The digging wheel is of the open type without axle, arranged to obtain the maximum depth of trench with minimum diameter of wheel. The hoisting drum for raising and lowering the wheel frame is mounted on the car body and connected with the jack shaft by means of a steel roller chain. The steering machinery is mounted under the car body, and is operated by a worm and worm wheel which are self-locking. The steel belt conveyor for removing the spool is 24 ins. wide and of sufficient length to dispose of material when digging at the maximum depth.

The general dimensions of this ditcher are: Width, 10 ft. 7 ins.; length of car body, 18 ft.; length over all, 25 ft. 9 ins.; height over all, 9 ft. 7½ ins.; weight on corduroy grip tractions, 19,500 lbs.

The Sioux Falls Spillway for Flood Relief of the Big Sioux River, South Dakota

By Francis C. Shenehon, Mem. Am. Soc. C. E., Consulting Hydraulic Engineer, 628 Metropolitan Bank Bldg., Minneapolis, Minn.

The Big Sioux River has its course in the northeastern corner of South Dakota. This region is characterized by a number of small lakes which doubtless have some reservoir value in absorbing flood waters. The river flows southward and has a length, as the crow flies, of about 150 miles, before it reaches Sioux Falls where the spillway to be described is located. The river itself meanders and doubles upon itself in a devious course which doubtless makes the line of travel of the water as much as 300 miles. The drainage basin above Sioux Falls is over 4,000 square miles in area. Approaching this city the river traverses bottom lands in which its bed is but slightly depressed below the general level of the country. The sub-soil is fine sand readily scoured and the river channel has shifted from time to time over this flood plain.

From time immemorial the river under stress of flood conditions has overflowed its banks and spread over the bottom lands. While this has created temporary inundations of some inconvenience, the great fertility of the soil is doubtless to be credited to the overflow. The sedimentary deposit from the sanding flood waters is a fertilizer.

Main Ditches

To assist the early drying-out in the spring of these rich bottom lands for cultivation and seeding, and to escape the hazard of overflow during the crop-growing season, two main ditches were excavated about ten years ago. Ditch No. 1 taps the river about three miles north of Sioux Falls and ditch No. 2 taps the river twelve miles above Sioux Falls, and joins ditch No. 1 about two miles above the city. While varying somewhat in section, the ditches may be thought of as 30 ft. wide at bottom, 54 ft. wide at water surface and 8 ft. deep in flood times. The river which approaches Sioux Falls from the north passes on west of the city, then makes a loop, which measured along the sinuous course of the river is about 26 miles long; then the river returns northward to Sioux Falls, descends over a red quartzite bottom, and passes on north again from the city at an elevation about 115 ft. below the elevation of its first approach.

The ditches mentioned above emerge from the river on the higher level passing toward the bank overlooking the river on its lower level. This bank is of clay and hills rising about 20 ft. to 40 ft. from a rim along the south edge of the upper valley.

The Original Spillway

To drain the ditches into the lower river gorge a cut was made through this clay rim and down the sloping bank towards the river; and this excavated cut was lined with light reinforced concrete. This was the original spillway and served for a number of years. In flowing down this concrete trough however the water had a descent of about 110 ft. in a distance of about 1,000 ft. This of course gave a high velocity and great destructive power to the water where it debouched into the river. I understand there was also a tendency for the water to escape under the lining. Ultimately

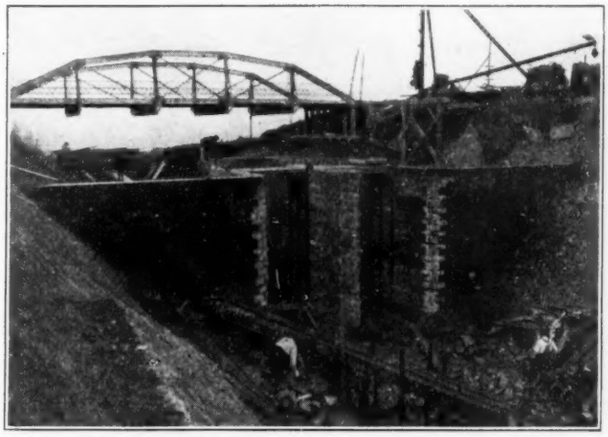


FIG. 2. CONTROLLING AND INTAKE SLUICES OF SIOUX FALLS SPILLWAY UNDER CONSTRUCTION.

in the spring of 1916 a flood of considerable magnitude wrecked the spillway and a gorge was cut back towards the clay rim of hills mentioned above, for a distance of 900 ft. This gorge has a depth of 100 ft., and has a width of about 300 ft. (See Figs. 1 and 5.)

New Spillway Designed to Absorb Energy of Water

Minnehaha County was faced with the need of putting in a spillway which would safely carry a flood flow somewhat

FIG. 1. VIEW SHOWING THE WRECKING OF THE OLD SIOUX FALLS SPILLWAY IN 1916.

in excess of that of the old spillway. It appeared a perplexing problem to the Board of County Commissioners, and in August 1917, the writer was called upon to design a structure which which would accomplish the desired purpose of safely taking 2,000 cu. ft. of water per second (900,000 gals. a minute) from the level of the valley floor to the level of the river in the gorge.

The problem presented was to absorb the energy of the water without destructive effects. Ordinarily a hydraulic engineer must build a structure to conserve the energy of water and convert it into useful power. Here the engineer was called upon to destroy the energy of water endowed with 25,000 potential water horse power.

Stated another way the problem was to affect the descent through 110 ft. of 5,400,000 tons of water a day, with a velocity

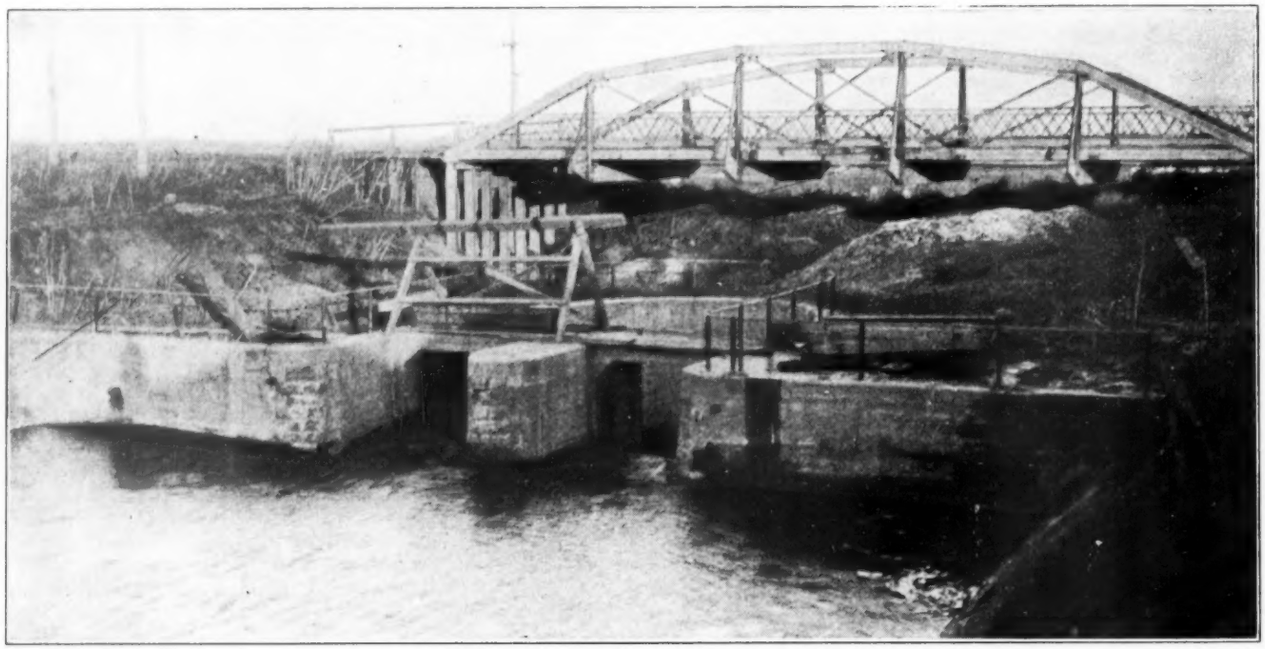


FIG. 3. VIEW SHOWING INTAKE SLUICES OF SIOUX FALLS SPILLWAY IN OPERATION DURING FLOOD OF MARCH, 1919.

in passing through the spillway of 35 miles an hour; and this water must be denied the possibility of the destruction which its enormous energy makes so menacing. It should be noted that active flow through the spillway does not take place more than a few weeks each year and therefore its development for water power is not financially feasible.

Sluiceways and Tunnel.

In working out a solution of this problem it was decided to enlarge the ditch for a short distance to slow up its velocity as it approached the descent; to pave with the local jasper or red quartzite a distance of 70 ft; then pass the water through sluiceways 8 ft. wide and 18 ft. deep. These sluiceways are provided with stop-logs so that control of the flow may be effected in case of need or desirability. The dimensions of the sluiceways give a flow of 2,000 cu. ft. per second when the water is 12 ft. deep over the sluiceway floor. With the water 2 ft. higher the discharge through the sluices will be 2,500 cu. ft. per second. (See Figs. 2 and 3.) After passing through the sluices the water drops into a shaft which tapers from 16 ft. in diameter at the water suface above, to 10 ft. in diameter at the bottom. In this shaft the water drops vertically 40 ft. and is then deflected by a great elbow into the tunnel which leads towards the gorge below. The tunnel has a level floor crosswise, 10 ft. wide, with vertical side walls 3 ft. high. The upper portion of the tunnel is a semi-circle of 10 ft. diameter. The tunnel takes the water from the foot of the shaft through the clay hills, and has a length of 216 ft., descending on a grade of 16.8 percent. (See Fig. 4.)

The Stilling Basin

At the tunnel portal, where it emerges in the gorge, the water passes through an open flume with vertical walls 8 ft. high and a floor 10 ft. wide. With a flow of 2,000 cu. ft. per second it is calculated that the stream will be 4 ft. deep and have a velocity of about 35 miles per hour. This stream then impinges on an overhead curving deflector beam which changes the direction of the water through an angle of 80 degrees, spreads it out laterally fan-shape as it descends, and projects it vertically into a stilling basin, 24 ft. wide and 25 ft. deep. This stilling basin is of massive reinforced concrete construction, and is founded on a mass of red quartzite embedded in coarse gravel. The foundation was solidly locked to the rock and the gravel spaces grouted under pressure. A reinforced concrete floor was placed over portions of the bottom where gravel seams were exposed. The larger part of the bottom of the basin is red quartzite, a rock so hard that it will cut glass.

The water projected into this stilling basin in a sheet perhaps 2 ft. thick and 24 ft. wide has its condition of a stream of high velocity and small section, converted to a stream of large section and small velocity. By frictional losses, expansion, and the lifting and changing of direction of the mass of water its destructive energy is largely eliminated as it emerges from the basin and flows towards the river.

The principal absorption of energy takes place in the basin, but the water issuing from the basin over a sill 15 ft. below the flood water surface and 20 ft. wide, does have left some considerable velocity and turbulence. The secondary expansion takes place outside the basin, but turbulence disappears 60 ft. down stream from the basin, where the water is running straight-away in a stream 100 ft. wide, towards the river.

Method of Making Hydraulic Excavation

In the original drafts for design it was proposed to extend the structure down stream about 80 ft. from the deep basin so as to contain within reinforced concrete walls the secondary turbulence. The foundation difficulties were found so great however in putting in the deep basin in sand under 20 ft. of water, that it was finally decided to let the water

excavate its own outer basin in the gorge. This was successfully accomplished in the 8-day flood beginning March 15 of this year.

In order to accomplish this hydraulic excavation without danger of landslides, stop-logs were placed in the sluiceways to cut the discharge down to 1,200 cu. ft. per second. Fig. 5 illustrates the hydraulic conditions of the emerging flood water in the gorge with this volume of flow. Where the heavy boiler shows, about 25 ft. down-stream from the stilling basin, the water is 30 ft. deep with rock bottom. Characteristic lateral eddies have scoured the gorge walls out as shown. When the flood flow began the basin was hemmed in tightly by steep slopes on each side. After eight days of discharge the basin has plenty of elbow room and is in no danger from lateral landslides.

Geological Conditions

The geological conditions exposed in the gorge walls show a top stratum of yellow clay of little tenacity tending to break down when saturated; under this is a stratum about 100 ft. thick of blue clay as tenacious as rubber and resisting current wash; underneath this blue clay is a bed of fine quartz sand saturated by small spring flow; below the sand are massive fragments of red quartzite embedded in coarse gravel, overlying the bed rock.

Getting down to adequate foundations for the stilling basin

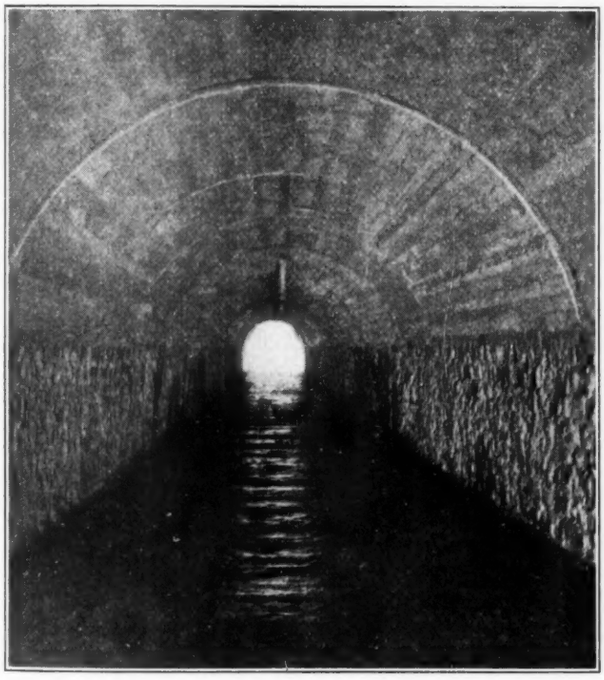


FIG. 4. VIEW SHOWING SMALL FLOW IN THE TUNNEL OF THE SIOUX FALLS SPILLWAY.

in this saturated sand was difficult. Water leaking into the cofferdam of steel sheet piling brought considerable sand with it and caused one serious landslide, and some minor slides.

Details

The shaft and tunnel were driven through the blue clay, which stood up without shoring, except in one section of the tunnel where a pocket of sand, gravel and water was encountered, which emptied about 200 cu. yds. of material into the tunnel. For the most part the tunnel was blasted and cut out of the tenacious blue clay, forming an opening 14 ft. wide and 12 ft. high.

The paving in the approach canal (See Fig. 2) is 1 ft. thick of quartzite blocks with cement mortar in joints. At the entrance to the sluiceways a concrete cut-off wall is sunk 6 ft. into the blue clay.

The controlling works, wing walls, sluice walls and shaft walls are of reinforced concrete 2 ft. thick. At the foot of the shaft, where the tunnel begins, the walls are heavier to meet the great stress of an 80 degree turn of the water. The tunnel and flume walls and floors are 2 ft. thick of reinforced concrete. The walls of the stilling basin are 3 ft. thick, heavily reinforced.

Protecting Concrete Against Erosion

In the old spillway the concrete was badly scoured by the swift silt-bearing water. In the new spillway all surfaces

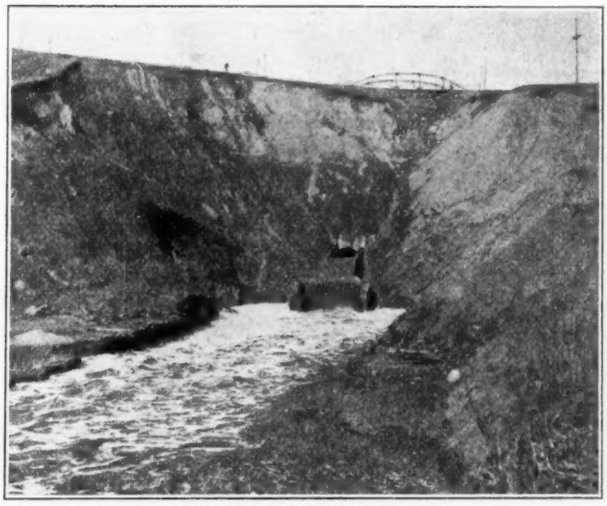


FIG. 5. VIEW SHOWING OUTFLOW THROUGH GORGE, SIOUX FALLS SPILLWAY, DURING FLOOD OF MARCH, 1919.

subject to the wear of high velocity flow are lined with red quartzite block built integral with the concrete. In Fig. 4 these walls of stone are 4 ft. high, with additional height near the elbow at the foot of the shaft. This is the estimated depth of the normal flood flow stream.

The flume is bridged from the tunnel portal to the stilling basin, so that the earth may drop away below it without hurt. This flume serves also to anchor the basin against overturning. It will safely transmit from the basin to the earthbound tunnel more than 200 tons.

FIG. 6. VIEW SHOWING TUNNEL PORTAL, BRIDGED FLUME, DEFLECTOR AND STILLING BASIN, WITH 1,200 CU. FT. PER SECOND DISCHARGE, SIOUX FALLS SPILLWAY.

Returning now to the stilling basin outlet, and the secondary turbulence in the gorge outside the basin, the question arises why a condition hazardous to the structure does not exist in the possibility of the swift current washing out the underlying sand and toppling the clay banks down. That is exactly what did occur when the flood wash began, but the

restriction of the volume of flow widened the gorge near the basin gradually. Little landslides were caused which dropped into the swift current and were washed away. But these landslides did not work upstream. That was closely watched and guarded against. After a sufficient gorge width has been hydraulically excavated, the sand will be covered over by a talis bank of blue clay which confines and protects it. The toppling down of the blue clay automatically provides this protective cover.

When the flood has passed and a condition of channel equilibrium is reached, the banks close to the basin will further be protected by a cover of large rock fragments to take the wash. The rock fill will be especially heavy where needed to check any possibility of upstream encroachment.

Personnel

The plans were approved by the State Engineer of South Dakota, Dr. Homer M. Derr, who made valuable suggestions for their betterment. Dr. Derr would have preferred a spillway of greater capacity than 2,000 cu. sec. ft.

The work was done by the Sioux Falls Construction Company, and appears to be an excellent job. Mr. L. M. Norelius was resident engineer.

The Board of County Commissioners has worked cordially with the engineers and the contractor to produce an enduring and interesting hydraulic structure.

The Importance of Adequate Drainage and Foundations for Road and Street Surfaces

By Clifford Richardson, Consulting Engineer, The Barber Asphalt Paving Co., Woolworth Bldg., New York, N. Y.

The satisfactory nature of any type of pavement or road surface is primarily dependent on the rigidity of the foundation which supports it. Inadequacy in this respect reduces all forms of construction to a common level of inferiority. Rigidity in a road surface cannot be obtained without suitable under-drainage and, for this reason, drainage is a feature of primary importance in the construction of roads and pavements.

Historical

This fact has been recognized for at least a century, but it has seldom been carried out effectively. The ideas of the older engineers, McAdam, Telford and others, in regard to road construction and the importance of the relation of drainage thereto, are widely scattered through the earlier literature of the subject. They were recognized and summarized in an interesting book by S. DeWitt Bloodgood, published at Albany, N. Y. in 1838, entitled, "A Treatise on Roads", in which it is found that sound principles had been established in the United States at that early date, by engineers who had an adequate comprehension of the subject, at least as far as the requirements of their day were concerned.

That this was a fact can be realized from some of Mr. Bloodgood's statements:

> "The strength of a road depends on the nature of the material of which it is formed, and of the basis on which it is placed."
>
> "McAdam's theory of road-making may be comprised in the following quotation from his Report to the Board of Agriculture, (vol. vi.p.46):—'Roads can never be rendered perfectly secure until the following principles be fully understood, admitted and acted upon, namely, that it is the native soil which really supports the weight of traffic; that while it is preserved in a dry state it will carry any weight without sinking, and that it does, in fact, carry the road and the carriages also; that this native soil must previously be made quite dry, and a covering impenetrable to rain must then be placed over it, to preserve it in a dry state.'"
>
> "The erroneous opinion so long acted upon, and so tenaciously adhered to that by placing a large quantity of stone under the roads, a remedy will be found for the sinking into wet clay or other soft soils; or, in other words, that a road may be sufficiently strong, artificially, to carry heavy carriages, though the sub-soil be in a wet state, and by such means to avert the inconveniences of the natural soil receiving water from rain or other causes has produced most of the defects of the roads of Great Britain. At one time, McAdam had formed the opinion that this practice was only a useless expense; but experience has convinced him that it is likewise positively injurious."
>
> "Drainage: In proper construction in this part of the business of road making, great care is necessary. The utmost judgment of the skillful surveyor will be called into action to enable him to make the best use of the natural facilities of the country, and to overcome the obstruction that he will sometimes meet with. In passing over flat land, open main drains, cut on the field side of the fences, must communicate with the natural watercourse of the country; they should be 3 feet deep below the level of the bed of the road, 1 ft. wide at bottom, and 5 ft. wide at top."

With the building of railroads, however, the construction of highways of the better type was gradually neglected, and but little attention was paid to the subject of drainage and foundations, with perhaps some exceptions.

In the seventies of the last century the condition of our roads was such that W. M. Gillespie, in a volume, published in 1872, entitled "A Manual of the Principles and Practice of Road Making," stated in the preface:

> "The common roads of the United States are inferior to those of any other civilized country. Their faults are those of direction, of slopes, of shape, of surface, and generally of deficiency in all the attributes of good roads. Some of these defects are indeed the unavoidable results of the scantiness of capital and of labor in a new country, but most of them arise from an ignorance either of the true principles of road making, or of the advantages of putting these principles into practice."

From this quotation it appears that road construction and maintenance were at a very low ebb at that period. They remained so until the bicycle came into common use. For the comfort of the riders good roads were demanded and a considerable effort was made to provide them. The difficulties of the present period, however, are to be attributed to the fact that motor vehicles and, particularly, motor trucks have become important features in the transportation of passengers and freight over our highways and streets. It is a form of traffic and travel which has made much more serious demands upon them and on the methods of their construction, especially, as regards drainage and foundations. As a result the problems relating thereto demand, and are receiving, more attention today than they have ever had, although their consideration is, even now, too often neglected.*

Drainage at the Present Time

It is evident that the demands made by the traffic which is carried at the present time by our main arteries of communication are such that the greatest stability is necessary for the support of their surfaces, and this can only be accomplished on a soil which is firm or made so by suitable drainage. In arriving at such an end the following points must be given consideration:

The travel and traffic to be carried.
Character of subsoil.
Drainage, natural or artificial.

*"Drainage Increasingly Vital with Growth in Heavy Traffic," by E. W. James—"Public Roads," Vol. 1, No. 3, July, 1918.

Climate.
Location.
Material available for construction.

The relative importance of these features will vary with different local conditions. There is no general rule which applies. In one case the character of the subsoil and the necessary drainage may be the ruling conditions, in another a severe climate, and in a third the material available for construction. Attention must be paid in a certain degree to all of them, however, in any case.

Location

As the solution of the problem of drainage and of the character of the foundation necessary for any particular road is dependent to a very large degree upon its location, the latter is, in this connection, an important consideration. It involves the application of both good judgment and experience, and due regard to the economic principles involved, that is to say, to the relation of the money expended and the results obtained. Like so many other problems which arise in building highways adapted to the use to which they are to be put, it is entirely a local one both financially and structurally.

Soil

As the support of a road surface is the soil upon which it, or its foundation, rests, the stability of the latter, or the imparting of stability to it, is a matter of primary importance.

Soil, as distinguished from sand, which is an aggregation of much coarser particles of mineral matter, is the fine residual of the weathering and decay of rock, associated with more or less organic matter of vegetable origin. Soils are of importance in road building since they form the initial foundation upon which the road is placed. Upon their character is dependent that of the drainage and artificial foundation upon which a road surface or pavement is supported. They may be classified in a general way as sandy, loamy and argillaceous, between which all degrees of gradations exist. Marl and peat are particular forms of soil identified by components which characterize them, in one case shells and in the other a large amount of residual matter of vegetable origin being important components. Any soil may be modified in character by the presence of sand or gravel.

A soil is of interest to the highway engineer chiefly as regards its stability, when properly drained, either naturally or artificially, that is to say, when any excess of water is prevented from accumulation therein in an amount sufficient or more than sufficient to fill the voids between the soil particles, thus involving instability which arises from such a condition. The presence of an amount of moisture only sufficient to be absorbed by the surface of the particles of soil but less than sufficient to fill the voids between the particles, will add to its stability and increase it beyond that of a perfectly dry soil. Sufficient water to form a film on the surface of the soil particles and thus develop a surface energy which will bring about cohesion of these particles may be an advantage as compared to a bone dry condition and undoubtedly exists very generally, but an amount to any degree beyond this would result in instability and also in disturbance by freezing, thawing and refreezing.* This condition is well illustrated by a sandy sea beach where as the tide recedes that portion in which the particles of sand are drained of excess of water, as the tide falls, still contains sufficient for the absorbed film on the surface of the individual grains to develop a surface energy which will bind the particles together in perfectly stable state, and one which will not be displaced under travel, whereas the same sand when perfectly dry, possesses no stability, the same condition existing at the other extreme, at that part of the beach nearer the sea and containing an excess of water. Attention need be called here only to the bearing of this relation on the stability of subsoils and the necessity for drainage. The solution of the problem of under-drainage in road construction is, therefore, largely dependent upon the character of the soil which is to be dealt with, that is to say, the state of subdivision of the particles of which it is composed. It is important that the surface of a road be impervious to water so that the bottom may be dry and stable. If these provisions are lacking every road surface or pavement, of no matter what type, will prove unsatisfactory and give no adequate return for the cost of construction, even with careful maintenance. This is, fortunately, beginning to be recognized.

The drainage demanded by any particular piece of road construction will depend primarily on the character, stability and dryness of the subsoil on which the road rests, its location, relative to its environment, and the climatic conditions which it is called upon to meet. It relates to the removal both of surface and of soil water. The character of the provision for the former will depend upon the surface area and the run-off to be taken care of; for the latter, on the nature of the subsoil upon which the surface is to be placed, the climatic conditions which are to be met, the lay of the surface of the road to that of the adjoining land and the traffic which it is to be called upon to carry.

Drainage is hardly necessary on sandy subsoils, for instance, such as some of those found on Long Island, New York, which in themselves will take care of water, except at low points, but it must be given serious consideration on heavier and especially clay sub-soils, in cuts and fills, particularly the former, and where seepage from slopes or hillsides may destroy the stability of the subsoil and reduce its capacity for carrying a load. In such cases an intercepting gutter for surface water and drain for ground water should be provided between the slope and the road. The necessity for the location of drainage for the removal of ground water should be determined in the spring, when frost is coming out of the ground, and for surface water during storms and periods of high water.

Roads on Fills Should be Drained as Well as in Cuts

The location of a road on a fill does not always insure good drainage if the supporting soil is clay, especially if there is a steep grade on an adjacent portion of the road. An example of a difficulty of this description has been cited by Mr. F. P. Arnold,* of Delaware, who states that:

> "In one location water came from a spring in a cut at the top of a hill, ran down the hill and half way up a fill over a railroad track—a total distance of 1,000 ft. Breaks were found all the way across this fill and when the stone was picked up and a ditch cut through the shoulder at the break furthest from the cut, a 2 in. stream of water ran for nearly a day."

He adds:

> "A stone-filled V-shaped trench, pointing up the hill and placed at the end of every clay cut, will eliminate such breaks in these locations. Furthermore, weeps should be constructed about every 50 ft. to let the water out through the hard shoulder."

This is an excellent example of the fact that a fill should be maintained in as dry a condition as a cut.

The necessity for careful drainage is also emphasized where the soil has no inherent stability in itself, especially when wet, and offers little resistance to displacement.

Drainage may, perhaps, be of less importance, in cases, where a Portland cement concrete foundation is provided, but in general, as evidenced by the behavior of concrete roads, under the action of frost, which develop cracks and defects extending longitudinally, it cannot be disregarded.

Proper drainage of a road is much more essential in

*Engineering & Contracting, 49, 238, 1918.

*Engineering News-Record, 80, 933, Nov. 15, 1917.

climates where frost and low temperatures are encountered than in a moderate or warm one, for reasons which are evident.

In the treatment of subsoils and in the character of the foundation placed upon them, local conditions must be given consideration. The most serious situation exists with clay subsoils which are exposed to extremely low temperatures in winter and which are thrown as the frost comes out of the ground in the spring. Examples which demonstrate this are illustrated by instances where insufficient drainage has been provided for bituminous and waterbound macadam surfaces in northern New York.* The only satisfactory way to meet such a condition is by removing the clay, which is encountered, to the depth that frost reaches, and replacing it with stone or gravel, with proper drainage, which will not be displaced or not as much so, by freezing and thawing.

In considering under ten heads the main problems connected with highway construction, Mr. H. E. Breed,† of the New York Highway Commission, classes the matter of drainage as second only to that of bond issues, calling attention to the fact that, although it is an elementary topic, it is too often neglected like many other self-evident truths. He adds:

> "Drainage problems are considered so easy to solve that any one may adequately handle them. True, there is but little theory involved in the application of the principles that make for perfect drainage, but that rare quality known as judgment comes in largely here, as it does in all successful engineering work. Greater care and judgment in respect to drainage are needed now more than ever before in order to increase the bearing power of our soils for the heavier loads that the traffic of today brings upon them.
>
> "This topic may seem more worthy of attention when I tell you that in 1916, 84 miles of improved highways in New York out of a total of 1,939 miles, broke up in the spring of the year. Of this, 43% was directly attributable to inadequate drainage. During 1916 about 75% of these weaker areas was repaired and 238 miles of thin pavement was resurfaced. It may have still more force when I tell you that in New York State in 1917, 48 miles of improved highways out of a total of 2,090 miles broke up in the spring of the year of which 18% was attributable to inadequate drainage.
>
> "The percentages given as attributable to inadequate drainage were reported by the men having charge of each section and the personal equation enters largely into the cause to which each break-up was made attributable. They are, however, the most accurate percentages that could be obtained of the inadequacies of our drainage systems. These roads were not built by guess but under careful calculation by some of the best road engineers in the country. They installed upon them drainage systems such as they thought ample, but they had not taken into account the large increase in traffic and wheel loading that we have today. The roads failed because they disregarded the pumping action caused by the excessive pounding of that traffic, which draws the water and fine material up to and through the crust of the pavement until the crust is broken and the road shattered.
>
> "I shall not attempt to suggest any scheme for the solution of the drainage problem, because each condition requires different treatment. Broadly speaking, however, drainage can be divided into two classes; surface drainage, and sub-surface drainage. Surface drainage is cared for by the crown of the road and side ditches with proper run-off to carry the water away from the road at frequent intervals so that it will not trouble us again as subsurface drainage. Every roadway should have ditches."

No better evidence of the importance of drainage, at least in climates like that of New York State, with severe winters, is needed.

It is unnecessary to go into detail here in regard to systems of drainage for ordinary conditions, since these are described in all their various forms and for different types of pavements and of road construction in text-books, in discussions of the subject before societies, in publications of the United States Office of Public Roads and State Highway Departments and in the engineering press. It is, however, necessary to insist upon the fact that in clay or heavy subsoils, especially in northern climates, if drainage is inadequate no amount of thoroughness in the construction of the foundations and surface of both pavements and roads will result in a satisfactory return for the money expended, even where the traffic is of the most moderate description. Adequate drainage for heavy clay sub-soils, in the coldest climates, can rarely be satisfactorily accomplished, and the only method of meeting such conditions is the excavation of the clay to a considerable depth and its replacement with material which can be drained, or which is not as liable to displacement by frost. In general, it may be said that drainage is a local problem and its satisfactory solution is more dependent on a study of local and individual conditions than upon fixed standards.

Foundations

The first essential in the construction of pavements and road surfaces of durable character having been shown to be a dry, that is to say a well-drained and firm, subsoil, as the result of either natural or artificial provision therefor, upon which to build and maintain a durable surface, another and equally essential factor in the successful construction of both pavements and highways is a suitable foundation. Its character will depend upon the conditions to be met. Practice, which might be excellent in one locality may fail in another. A concrete foundation will, of course, be more costly than one of broken stone, but a foundation of this type 4 ins. in thickness will be stronger than a loose one of 2½ ins. broken stone of 6 ins., and the difference in cost will not be a serious consideration since the much smaller amount of stone used in the 4 in. foundation will largely make up for the cost of the cement and sand in the concrete. In a concrete foundation when once laid, we have an asset which can be counted upon for all time, while a broken stone foundation is necessarily of a more or less temporary nature, owing to its displacement under travel, and disappearance, in some cases, into the soil which should support it.

Concrete Foundations

There seems to be every reason why, in the building of our highways, an effort should be made, at least in the case of those which are to carry heavy travel, to construct them with a concrete foundation, which will last for all time, and on which a wearing surface can be constructed, at such intervals as may be necessary, something which can be easily and economically done, and the life of which depends on the rigidity of the support afforded it. It is evident that as we are now constructing surfaces for many of our main arteries of heavy travel, we are throwing away large quantities of money by lack of inadequate support of them. The result is much the same as if expensive buildings were erected without suitable foundations. This question of adequate foundations is one which should receive the careful attention today, and one which, if neglected, will do more than anything else to hamper the development of good roads, since great disappointment must arise when, within the course of a few years, it is discovered that the wearing surfaces which are now being constructed are so inadequately supported that they have given

*See illustrations in Trans. Am. Soc. C. E., 1912, Discussion: Road Construction and Maintenance.

†Engineering News-Record, 80, 610, March 28, 1918.

no reasonable return for the cost incurred in building them.

An adequate return, therefore, for the money expended on any type of pavement or road surface is dependent, after the provision of a dry support, on the rigidity of its foundation. The necessity for strong foundations is emphasized at the present time by the fact that our street pavements and main arteries of communication are called upon to carry a heavy burden and a very large traffic, owing to the advent of the motor vehicle, more especially the motor 'bus and motor truck, the latter rapidly increasing in capacity to such an extent that it is recognized that means for regulating it must be considered.

Foundations may be differentiated, primarily, as those depending on the soil alone as a support, known as natural or subsoil foundations, and those provided artificially which are of many types.

Foundations, like drainage, are a local problem. To meet it satisfactorily involves a careful consideration of the environment of the road and the uses to which it is to be put. A foundation of a thickness of only 4½ ins. which appears to be satisfactory in the climate of southern California, would be useless in northern New York. A different thickness may be called for on a hillside and on a level and in low as compared to high ground. The nature of the subsoil or manner in which the road is supported from below will also have a decided influence, a weak support calling for a heavier foundation. Again, if the drainage is not entirely adequate, a heavier foundation will be demanded. Its character will also be influenced by the materials which are available for its construction. If these are of the best, the thickness may be less than would be desirable with inferior materials. Last of all the character of the travel to be carried must be given due consideration. If heavy motor trucks form part of it, proper provision, greater thickness and stability, must be made for their support.

Thickness of Foundations

In any case the foundation must be perfectly rigid and free from vibration, that is to say, it must have complete stability under the conditions it is called upon to meet and the loads which it will carry. No rule can be laid down for a thickness suitable for all conditions. In some instances, as on city streets, from 8 to 12 ins. or more of concrete may be necessary under the heaviest travel, while, as has been said, in California 4½ ins. in that climate, seem satisfactory for the main country highways.

According to the London Times of Feb. 13, 1913, the following depths of foundations have been used in London and in the neighborhood.

> "In Bermondsey, for instance, while concrete 6 in. deep was formerly sufficient, the depth is now being made 9 ins. or even 12 ins. In Hackney foundations which were sufficient a few years ago are now found quite inadequate, and in new work the concrete is being made 50 percent thicker. The Hampstead surveyor considers that the life of wood paving has undoubtedly been reduced by one or two years, and it has become necessary to increase the thickness of the concrete foundations from 6 ins. to 9 ins. In Holborn cement foundations 12 ins. thick are being laid in places where a thickness of 6 ins. was sufficient ten years ago. In Paddington concrete from 10 ins. to 13 ins. thick is being used on wood-paved carriage ways where the thickness was originally about 7 ins., and in Westminster the specifications now used when new foundations have to be laid provides for 1 in. of floating and 8 ins. of concrete foundation instead of 6 ins."

The necessary thickness of foundations under the surfaces of our country highways will vary with local conditions, as will the determination of its character, whether it should be concrete, a Telford support or broken stone or gravel placed on the soil. With the increased construction of durable surfaces provision for proper drainage and adequate foundations must receive greater attention than they have had up to the present time and many of the failures on our country highways are due to deficiencies in these directions. To these deficiencies must be added the carelessness of contractors in carrying out work and lack of inspection on the part of state and local authorities. The best materials cannot give results commensurate with the increased expenditure incurred in using them unless the surfaces constructed are properly supported and drained, which is too often not the case.

There are but a few types of foundations which have been recognized as the result of service tests, as being satisfactory for road surfaces subjected to heavy travel, and some of these only under favorable conditions.

Portland cement concrete of sufficient thickness, properly proportioned and supported on a well-drained subsoil, is probably the most satisfactory foundation for pavements and road surfaces. Old waterbound macadam, which has been thoroughly compacted under travel, has also demonstrated its suitability, or a course of broken stone 2½ ins. or larger in size, put in place for the purpose, on a dry, firm subsoil, has given satisfactory results as a support for asphalt surfaces under particular conditions. Gravel surfaces, new or old, when in good condition, have also served.

All Public Engineers Should Support the American Association of Engineers.

To the Editor:

In reading the March issue of MUNICIPAL AND COUNTY ENGINEERING I came across your editorial dealing with the activities of the American Association of Engineers in connection with wages paid railroad technical engineers. May I presume to answer your query as to whether similar action could not be had on municipal and county engineers' salaries?

This question is already before the association, as witness an editorial on the subject in the March issue of the Monad (which is quoted below), and a letter addressed by the association to Mayor Thompson, of Chicago, and published, I believe, in the January issue of the Monad.

I am sure that Mr. C. E. Drayer, national secretary, who may be found at 29 South La Salle street, Chicago, Ill., will be glad to give any further information he has as to what is to be done in this matter.

The important thing now is for public engineers the country over to come to the support of the A. A. E. as the railroaders have. Here in Cleveland they are doing just that and are giving us their vigorous support in our railroad problem. Such co-operation is essential to the success of the association's efforts.

To the extent of my ability I shall be glad to be of any possible assistance in this matter.

Very truly yours,

512 Columbia Bldg., Cleveland, O. ERNEST R. TAYLOR.

The editorial from "The Monad," to which Mr. Taylor refers, follows:

"The Next Group Needing Organization Help

"As soon as the railroad program is well in hand, consideration of a program to include the problems of all other engineers in public service, particularly municipal, county, state and federal government, will be opportune. All who have given thought to the subject agree that the work involved in the field of the public engineer is of greater magnitude and more difficult than that in the railroad field. It includes not only the question of pay, but the placing of engineers in positions they should hold, the establishing of standards of efficiency and the supporting of the engineer in public service against the forces that are often found in combination to pre-

vent the realization of the high degree of service the engineer desires to render. Let us be thinking and girding ourselves for the work ahead.

"Organization is the only way."

(It is strongly urged that municipal and county engineers act on Mr. Taylor's suggestion "to come to the support of the A. A. E." —Editor.)

An Engineer's Thoughts on the Labor Situation

By Hugh W. Skidmore, Civil Engineer, Chicago Paving Laboratory, 160 N. Wells St., Chicago, Ill.

The civilized world is face to face with the labor question. The problem is indeed a practical one and cannot be solved by theory alone. We have felt this thing coming for sometime: thoughtful, far-seeing men of affairs have told us of the impending danger and have warned us that something must be done. Having been adequately forewarned, and having at least a fair understanding of some of the things which must be done, we now come to the moment of action.

Action must not be delayed and it must be decisive. Shall organized labor be dominated by Bolshevism and I. W. W.ism?

Gompers or Bolshevism

It is only natural that we should consider such a thing impossible in this free country, where labor, along with the rest of us, has so forcefully demonstrated its patriotic mettle during the time of stress. I believe organized labor will not submit to this vile influence. I am inclined to place considerable confidence in these words from the lips of Samuel Gompers in speaking of the Bolshevik element in labor union,—"It is from the activity of this radical element, the American Bolsheviki, that labor, organized for justice and right, has earned countless enemies and, indeed, suffered through the unfavorable light they have cast upon it."

"But the mental cobwebs of the past have been swept away by war. Organized labor in the United States will not be disrupted. Organized labor will fight with every means within its command the insidious propaganda the Bolsheviki are using to reduce the ranks of its members. Not only will organized labor protect itself against the contagion of Bolshevism; it will protect the republic."

Notwithstanding the fact that the president of Organized American Labor has expressed himself in so determined a fashion, the problem cannot be solved by labor alone; organized labor cannot rid the country of this pestilence unaided. No more can labor, working alone, hope to rectify some of its own more serious shortcomings without considerable delay and great cost to the public. The problem embraces too much that concerns the employer, that concerns us all, to be worked out entirely from the labor standpoint. Our social and economic fabric is of such delicate texture, is so closely woven and interwoven, that no one force may act entirely independent of the others; not without destroying the pattern.

Labor comes out of the war with much gained and likewise much to be done in order to retain what has been won. Wages have been uniformly and substantially increased, and it seems generally understood that present prices will obtain for some time to come; the voice of labor is heard in every discussion of vital questions—we no longer conceive of a conference group from which representatives of organized labor are excluded; in the majority of cases employer and employee understand each other better; and labor has a clearer knowledge of its own faults and their possible remedies. In the last two results will be found the means of retaining and enhancing the first two.

Labor Radicals

Under pressure of war conditions the bars have been unwittingly let down to such an extent that thousands of radicals have gained admittance into the ranks of labor unions. In many cases this radical element has actually assumed leadership. With the possibility of unemployment ahead the appeal of these propagandists becomes all the more potent.

Like a malignant disease which contains the germ of self-destruction, Bolshevism and I. W. W.ism would ultimately destroy themselves, because they are fundamentally wrong. Granting that this filthy epidemic (there is little if any difference between Bolshevism and the I. W. W.) should become so virulent that it would consume itself, or should even gradually wear itself out, imagine the damage and suffering that would be wrought while the course was being run. The case is not one for homeopathic treatment—an operation is necessary—the offending element must be completely eliminated.

Deport These Foreign Devils

There is no room in this country, nor in the world, for any institution that seeks a selfish and false end, that disregards the rights and property of others, that openly denounces and seeks to destroy the government, and last but not least holds as false the sanctity of the home. The weapons of this monster are malicious misrepresentation and suppression of fact, sabotage, thieving, rape and murder. Law, honor, justice, love and charity are not to be found in the Bolshevik code of ethics. This "red plague" must be stamped out thoroughly and at once. Deportation should continue until every last one of those trouble seekers and trouble makers is back where he belongs. The civilized world will find the task of dealing with these chaps much easier if they are segregated in the countries which bred them.

Manifestly, then, the first task which labor organizations must set themselves to, is this much needed housecleaning. But after the cleaning out, the house must be disinfected and put in order. In other words, there are certain methods and practices of which labor has long been guilty—which the public has considered the necessary evils of organized labor—that must either be adjusted or discarded entirely.

Exploiters of Wage Earners

The members of labor organizations must cease their humble acceptance of the dictation of unscrupulous and greedy officials. In so saying, I do not intend to convey the impression that all labor officials are of necessity greedy or unscrupulous. The members, themselves, must actually run their own organizations, they must see for themselves where their money goes—they must legislate and administer and stop being "legislated," "administered," and assessed to suit the convenience of a few, whose only interest in the advancement of the cause of labor is measured by the amount of personal gain available. In the past these grafting labor leaders—major and minor union officials—have been one of the chief causes of difficulty between employers and employees—their existence has long been common knowledge.

Labor Union Reforms

Labor unions must conduct their affairs in a businesslike manner. Petty haggling and scrapping between local organizations must stop. Agreements with employers must be kept, if the employer is to be expected to abide by his bargain. Strikes must not be called and arbitrated afterward. The sympathetic strike is one of the most intolerable and unjust acts that labor has been and still is guilty of. They are seldom justifiable and should, if ever, be ordered only as a last resort. If unions are to serve as employment clearing houses for the various trades, the requirements for admission into the unions must be raised and strictly enforced; worthless, inexperienced and unskilled workmen must not be sent out as first class artisans.

In short, labor unions must give the highest possible grade of service both to the laborers themselves and to the employers of labor. Labor rightly organized and properly operated be-

comes a powerful force for good in direct ratio to the justice of its intentions and fairness of its methods.

Obligations are Reciprocal

The cleaning of the house in which labor dwells will by no means solve the problem. Simultaneously with it must come some monumental changes in the attitude of the majority of employers toward the rights of the workers. They are human, they are fellowbeings. They desire and deserve the best of working conditions, good homes, clean amusement and above all a tangible interest in the things which their hands produce.

After all the question is a business proposition. The employer representing capital and invention provides the materials for production and the laborer furnishes the means of production—together they produce. Neither is independent of the other, their interests are one.

Analysis of the situation reveals the truth, and truth is fundamental. The engineer builds upon fundamental truth, builds for the comfort and welfare of humanity in general. The vision of the wide-awake engineer need not be stretched very far to bring into view the unlimited scope of his opportunity. With the inevitable readjustment, reorganization and reconstruction already on the way, the engineer will find his greatest chance to serve humanity in a manner that will add immeasurably to his standing among men in all walks of life.

Principles and Procedure in Classification and Standardization of Salaries of Railroad Professional Engineering Positions

By J. L. Jacobs, Consulting Industrial Engineer, Chicago, Ill.

(Editor's Note: This abstract of an address delivered at the recent Railway Engineer's Conference held in Chicago shows the trend of the times toward the standardization of engineering positions and the fixing of an adequate minimum wage for each position. The author's presentation is of interest to all engineers wherever, for the moment, employed.)

(1) *General Considerations*

One of the far reaching results of the world war is the creation among the industrial leaders of all sides of a desire to unite on the work of the industrial and social reconstruction. The policy of American industry in the future, is to be based on democratic cooperation as against the policy of autocratic exploitation.

This frank and full-hearted cooperation of all the human factors concerned is vitally essential to the success of any plan dealing with economic and social problems. With a determined endeavor to do justice to the greatest number, to remove causes of industrial friction and to develop the spirit of national service, there is bound to come about incalculable economic, social and political benefits to all.

The Classification and Salary Standardization Movement

The realization that the human element is the most vital factor in service and production, has brought nation-wide and intensive consideration to the problem of employment. An important result of this consideration has been the evolution of the movement, referred to as the classification and salary standardization movement. Employment classification and salary standardization has made great headway because through it there comes justice and fair dealing and better understanding and harmony, both of which are indispensable in this day of competition for efficiency and production.

It is up to the professional engineers to take a leading position in this work. The activities of the American Association of Engineers along these directions are noteworthy examples of what can be done in the direction of developing constructive thought and action with reference to the economic and social status and ideals of the engineering professional groups. There is nothing that can stop this positive movement. These activities must be the forerunners of nation-wide action through all the professional engineering groups.

Present Demoralizing Factors

Inequalities in salary rates for positions having similar duties and responsibilities; interpretation and readjustment of salaries and working conditions without definite and sound bases; lack of standards of duties, responsibilities and qualification requirements; multiplicity of misleading and unnecessary titles; inequitable and unsystematic practices concerning selection, assignment, promotion and other employment conditions—all these have a demoralizing and stagnating effect on employes, employers, and the community.

This constructive program contemplates not only the elimination of inequities and inequalities in the compensations and opportunities of employment but has for its objects the formation of sound and definite bases for the determination and regulation of salaries and employment conditions; the development of practical standards of service, duties and qualification requirements; the establishment of clear and uniform understanding of the obligations and advantages of employments; the introduction of definite procedures governing selection, advancement, promotion and retirement on the basis of merit and seniority; and detailed fact bases and organization necessary for effective administration of all matters of employment.

Justice for Railway Engineers

The work now under way by the group representing the railroad professional engineers in the setting up of standards and uniform salaries and employment conditions for professional engineering positions in the railroad organizations will be of great aid to the district railroad officials, to the railroad adjustment boards and other agencies and will give impetus for similar action on the part of other professional engineers and employers. As a result of this work there should be made available for the first time, equitable, clear and systematic bases of dealing with and settling problems of the relations between men in the engineering profession and the industrial world.

The establishment of uniform and fair standards for the regulation of salaries and employment conditions for professional engineers is particularly opportune because of some steps already taken by governmental departments and representative organizations of workers and industrial concerns. Regulations already established by some of the industrial, governmental and labor organizations and included in agreements between employers and workers of many industries and the labor policies established by a number of governmental agencies are good examples of the steps already taken to develop more equitable and uniform methods of compensating employes for services rendered.

(2) *Essential Principles*

Essential features and underlying principles for sound classification and salary standardization have been developed as a result of intensive studies, experiences and observations of employment situations in many services. Professional engineers and employers would do well to adopt the constructive method and principles that have been evolved in various industrial and governmental services and are considered by many to be the most significant development of the method to improve industrial and economic conditions. These essentials and principles are set out as measuring standards for the classification and standardization of the railroad professional engineering positions as well as for other professional engineering groups.

As the plan proposed for the railroad professional engineers measures up to these standards so will the broad purposes be attained. The program of service and standardization of all the professional engineers should be the program of the railroad professional engineering group and that program should include the following fourteen essentials:

(1) Equitable and logical basis for fixing and adjusting salaries in relation to duties and qualification requirements and cost and standard of living.

(2) Definite wage differentials for different positions based on special work and qualification requirements, location and other special employment conditions.

(3) Classification of positions into functional classes, all positions being placed into classes according to general character of duties and into grades according to responsibility and difficulty of work.

(4) Standard and distinctive titles for all positions having similar duties and work requirements.

(5) Definitions of duties and responsibilities for each position.

(6) Definitions of qualification requirements for each position.

(7) Definite and equitable plan for recognition of efficient service and seniority through periodic advancement—particularly applicable to the lower grade positions.

(8) Definite lines of promotion for employes in the various groups and grades.

(9) Definite regulations for the determination, adjustment and control of salaries and working conditions.

(10) Standards of service for use as a basis of advancement, transfer and increases based on efficient service and seniority.

(11) Basis for the establishment of co-operative relations and measures between employes and management to improve social, economic and industrial conditions.

(12) Definite plan of administrative machinery for insuring equitable and orderly handling of problems of classification, salaries, working conditions and other matters of mutual interest.

(13) Definite formation of effective and fully representative associations for studying, developing and advising on the industrial, economic and public matters which are of common interest and for mutual support.

(14) Definite proposals for the next steps in the improvement of the status of professional engineering and the development of positive methods and ideals for service and employment.

(3) *General Procedure*

The following general procedure could be successfully applied in connection with the broad program of classification and salary standardization for railroad professional engineering positions as well as for the other professional engineering groups.

(1) Establish cooperative relations with representatives of professional engineering groups and associations, employers, and governmental agencies with a view of obtaining common understanding, full-hearted consideration and support in the development and establishment of the standardization program.

(2) Determine the divisions of professional engineering groups and the order in which classification and salary standardization for the same are to be developed.

(3) Collect for analysis, information and data from reports and documents containing laws, rules and regulations and descriptions of the organization, work and qualification requirements of the positions under consideration.

(4) Collect for analysis, information and data on cost and standard of living, hours of work, and other working conditions for the respective positions by districts and for the country as a whole.

(5) Develop groups of occupations setting forth standard and distinct title designations, definition of duties and qualification requirements; character of occupations; and lines of advancement and promotion.

(6) Establish factors and standards for the determination of basic salaries and differentials dependent on educational requirements, cost and standards of living, working conditions, and special qualifications.

(7) Develop standards of service as a basis for selection, assignment, transfer and advancement according to service and seniority.

(8) Prepare code of regulations and conditions as part of the general standardization plan.

(9) Hold conferences with representative of engineering groups and employers with a view of obtaining suggestions as to changes in classification standards and factors, and approval of the general plan.

(10) Prepare regulations and procedure on the manner and method of applying and administering the standardization program.

Obtaining Proper Recognition of the Engineering Profession

By W. W. K. Sparrow, Chief Engineer, Chicago, Milwaukee and St. Paul Railroad, Chicago, Ill.

(Editor's Note: These excerpts from the conservative address of Mr. Sparrow, delivered at the recent salary conference of railway engineers in Chicago, would have been considered radical only a few years ago. Then only the chainmen dared express themselves freely while waiting for the transitman to set-up over the hub. Gradually those higher and still higher up have started speaking right out in meeting about engineers' compensation, hours, etc. With half an eye one can see that a new day for the engineer is coming; it is almost sun-up now.)

Cause and Effect

I think the training of the engineering profession teaches us the law of Cause and Effect and that to every action there is an equal and opposite reaction. Consequently there must be a cause for the lack of recognition and interest in us. Therefore, before prescribing a remedy, we must first ascertain the cause.

To me the answer to this question is largely our own lack of interest in affairs outside of our profession, and also our lack of organization and concerted action. The engineer, as a rule, is diffident and modest; he has stood aloof from and taken little interest or activity in matters of public and political importance and the activities of our societies and associations have been largely, if not exclusively, confined to technical matters within the profession and even in those affairs little or no effort has been made to bring to the attention of those outside of the profession the part that it has taken and is taking in the progress of the world.

I have stated that as a profession we have taken little interest in other than technical matters and as an illustration of how the profession suffers as a result of such lack of interest, I would call your attention to the Newlands bill, introduced in the United States Senate at the first session of the 64th Congress for the purpose of creating experimental stations in engineering, similar to the experimental stations already inaugurated in agriculture. The introduction of the bill was the result of the awakening which the war produced and which led to fresh and renewed activity among the advocates of federal support for technical and engineering research, which it was felt would greatly assist in the development of all industrial resources. The bill failed and I am sorry to say that its failure was mainly due to the lack of active interest on the part of the engineers and those interested in the development of our industries.

An Open Profession

Another contributory cause is, in my opinion, the absence with few exceptions of state or national regulation in the practice of the profession. In the majority of our states any one who so desires may start to practice the profession of engineering without let or hindrance. Our profession in this respect is in about the same position as the medical profession was one hundred years or more ago when any apothecary could practice medicine, just as any plumber can today practice engineering as a sanitary engineer. Everyone today knows that a doctor must be licensed by the state to practice medicine and

that before he is able to obtain that license he must be properly qualified. In England the social class is, or was, more distinctive than in this country, and there was, and is, unless the war has eliminated it, still a distinct line of separation between classes and the social class to which he belongs is distinctive of a man's position in life. Before the medical profession was subject to state license and when any "quack" could legally practice medicine, a doctor or "leech" as he was often termed, had little or no social recognition. In England today the medical profession has taken its place in society and receives the recognition of all, and the first step in placing it on the plane it now occupies was in requiring every one who practiced medicine to be licensed to do so by the state.

What Licensing Has Done for South African Land Surveyors

In South Africa land surveyors, or government land surveyors as they are known there, must be licensed by the state to practice. In transferring or subdividing land the deed or legal document must be accompanied by a plat giving the necessary information in a prescribed manner prepared by a government land surveyor. The plat and survey must be submitted to the surveyor-general's office, where it is checked and record made of it. No transfer, subdivision or plat of land has any legal standing unless the work is done by a government land surveyor and the survey passed through the surveyor-general's office. The qualifications of government land surveyor are high. He must pass a very rigid theoretical examination and if successful in that, a practical one. It requires about three years' hard work to qualify. The result is that the Cape Government Surveyor has regular fees which give him a better return than the average engineer in that country and his profession, which is only the kindergarten of engineering, has received recognition and standing both in that country and out of it. I have heard it said on more than one occasion, and I believe with truth, that nowhere has the practice of land surveying been brought to the standard of South Africa.

Education Too Narrow

A further cause, I believe, lies in our education, which I think has been too much along technical lines and not enough attention paid to education of a general nature. The result is that the outlook and view of the young engineer leaving college is inclined to be too narrow and technical and he is often not sufficiently well informed upon, or his interest aroused in questions other than those of a technical nature.

Three Prime Requisites to Greater Recognition

Summarizing what I have said, my views as to the three prime requisites to obtaining greater recognition for the Engineering profession may be stated as follows:

1—Organization
2—Licensing
3—Broader education, interest and activity in other than purely technical matters.

Trade Union "Methods" Opposed

A letter in a recent issue of the News-Record advocated an Engineering Union affiliated with the American Federation of Labor, and I desire to state clearly and beyond possibility of misunderstanding that I am unalterably opposed to any organization along the lines of the labor unions, or perhaps it will be more correct to say to the methods adopted by those unions, as it is not the organization, but their methods, to which I am opposed. The question of organization is receiving the thought and attention of many engineers and we must be quite clear and definite as to the kind of organization we want.

It would be outside the range of this discussion to enter into an argument upon the merits and demerits of the struggle between labor and capital, but I am convinced that the engineering profession as a whole would never countenance the adoption of methods destructive to our economic welfare. Strikes and lockouts are economically unsound and an extensive application of the movement must inevitably lead to economic disaster. No matter what the argument, genuine or specious, made in support of the use of the strike threat, the cumulative result is the undermining and destruction of governmental authority and industrial enterprise. Our profession is constructive, not destructive, and we cannot countenance for a minute the adoption of such methods. There are other objections to the methods of trade unionism, one of which is that it destroys individuality and initiative and tends to reduce the efficient to the level of the inefficient.

For a League of American Engineers

It is not, in my judgment, necessary in order to secure recognition of the qualifications and accomplishments of the engineering profession and readjustment of the compensation paid, so as to be adequate for the services performed in comparison with and in relation to the compensation paid to others, to resort to or adopt the methods of organized labor, and to do so would lower, instead of raise, the standards of the profession. Unity and concerted action are, however, necessary, and what I would like to see brought about would be an organization known as the United States Association of Engineers, similar to the United States Chamber of Commerce, which is the national organization of the business men of America, and which would embrace all branches and existing organizations, civil, mining, electrical and mechanical. Such an organization would have for the different branches of the profession, its section devoted to technical discussion and research; its section devoted to the promotion of the economic welfare of the engineer; its section devoted to matters of political and public interest, as for example, education of public opinion to the advantage and desirability of having engineering representation on public bodies having to deal with questions and problems involving engineering knowledge and experience, the appointment of engineers to public positions, involving similar knowledge and experience, the adoption of a National Department of Public Works and many other similar and important questions. Such an organization, with its supreme, or chief executive council, made up of representatives of all branches of the engineering profession, would command the attention and respect of the nation.

This may seem to many an impracticable dream, but today when we are dealing with a League of Nations why not a League of the American Engineering Associations and Societies? The framing of such a constitution ought to be simple compared to that of the League of Nations. Nothing, of course, can be accomplished without a start, and as a start we have the American Association of Engineers, the only engineering organization I know of in this country devoted to other than technical matters. Let us develop it and build it up along such lines that it will stand to the engineering profession in the manner that the Chamber of Commerce stands to the business men of America.

Some Good Advice Here

I am a railroad man and am speaking, I presume, largely to railroad men and, of course, that is the branch of the profession, which, as railroad men, we are most interested in. At the present time I do not belong to the American Association of Engineers. I have, with the conservativeness of the land of my birth, hesitated in joining until I felt quite satisfied that the objects and methods of the association were along the right lines. I have reached my decision and am going to send in my application for membership this month and shall urge, not only railroad engineers, but every engineer of my acquaintance, to join the association and lend a hand. We should not rest in the organization of railroad affairs until we see every railroad in the country with its chapter or division of the American Association, with sub-divisions over its entire system, each subdivision to have its own officers, reporting to the chief executive council for that railroad, which in turn would report to the railroad council of the national association. Let us invite the cooperation of our sister organization, the American Railway Engineering Association, and build up a nucleus of a national association, embracing all branches of the profession.

One Voice for the Whole Engineering Profession

While urging complete organization of railroad engineers, I do not want anyone to go away with that as the goal in view. A small organization of one section of the profession will not accomplish the desired result. We must have an organization which, when it speaks through its duly elected representatives, will speak for the whole engineering profession of the United States. That voice will be heard and listened to. We railroad engineers can, however, set the necessary example and strive to organize the railroad section of the national association in such a manner that it will serve as an incentive to other branches of the profession to do likewise.

Whether for good or for ill, the individualistic age is almost a thing of the past. We have in the last ten or fifteen years seen some great changes, but the changes in the next ten or fifteen years will, I think, be much greater. It is not so very long ago when a man could beat his horse or his child as much as he liked. Today he cannot, and as an illustration of the restriction that is being placed on the individual, he has not, or soon will not have the privilege of abusing himself by drinking what he likes.

The movement of the day appears to be in the direction of organization by classes, and the engineering profession ought to be, and I trust is, alive to the movement. Therefore, let us invite the cooperation of all and use our influence in every direction to build up a national association which will embrace all branches of the profession and have as its object not only the advancement of technical research, but the economic, social and political welfare of the profession as a whole.

City and County Engineers Report Public Works Activity in all Parts of the Country

In the two latest issues of Municipal and County Engineering numerous letters have been published reporting construction activities in various cities and counties throughout the country. These letter have clearly reflected the optimism of local authorities and have reported specific plans and progress. A splendid construction year is now an assured fact. The present article gives reports from more city and county engineers on their plans for this season. Additional information of this sort, drawn from authoritative sources, will be published each business daily in the special daily reports issued by Municipal and County Engineering.

Chicago, Ill.—Bureau of Engineering

John Ericson, City Engineer, writes:

"The Bureau of Engineering of the city of Chicago has under contemplation the following work for the year 1919:

"Completion of Franklin-Orleans street bridge, total cost, $946,500.

"The foundation on the south side of the bridge is finished and work is going on on foundation on the north side.

"Completion of Wells street bridge, total cost, $1,450,000.

"Work on foundation on the north side of this bridge is under way. The entire bridge is estimated to be completed about August 1, 1920.

"New bridges on which work will be commenced in 1919:

Kimball avenue bridge, estimated cost	$ 70,000
Lawndale avenue bridge, estimated cost	50,000
Addison street bridge, estimated cost	175,000
Madison street bascule bridge, estimated cost	935,000
Twelfth street bridge, estimated cost	1,000,000
Twelfth street viaduct (east of river), est. cost	2,000,000

"There are a number of installations in connection with the water works, such as boilers, auxiliaries in pumping stations, etc., amounting to about a half million dollars, that will be done during the year.

"It is also contemplated to commence work on the new water tunnel in Western avenue and 73rd street, together with a pumping station to be located at 61st street and Western avenue, at a total estimated cost of about $3,000,000. This is, however, contingent on funds being available for this purpose, the appropriation bills not yet having been passed by the City Council.

"This is the principal work, so far as this Bureau is concerned, that is under contemplation for this year."

Pittsburgh, Pa.

N. S. Sprague, Chief Engineer, Bureau of Engineering, Department of Public Works, writes:

"The city of Pittsburgh proposes the following.

Sewer construction	250,000
Bridges	100,000

"The city has also under consideration a People's Bond Issue, amounting to upwards of $12,000,000, of which the principal items are as follows:

Street improvements	$1,500,000
Street repaving and resurfacing	1,000,000
Sewer construction	1,400,000
Bridges	500,000
Park Improvements	500,000

"This bond issue has been under consideration for several years past, and it will undoubtedly be voted favorably on by the public.

"There has been a decided demand for public improvements from every section of the city. The various boards of trade and other civic organizations are constantly requesting improvements which have been postponed on account of the great world war. This perhaps more than any other cause will tend to produce greater construction work than was at first anticipated. There is not now any problem of unemployment in this section of the country, but it is the duty of state, municipal and other political subdivisions to carry out large programs of public improvements to provide 'buffer' employment in this gradual change from a war to a peace bais."

Laconia, N. H.

Chas. A. French, City Engineer and Superintendent of the Department of Public Works, writes:

"It is proposed that a much larger amount of construction work, such as streets, roads, pavements, and sewers, etc., be undertaken this season than ever before, not only to make up for what was planned but not constructed during the war but also to give employment to those temporarily out of work on account of the readjustment necessitated by changing industries from peace to war basis.

"It is to be hoped that all may see the necessity of reducing the price of building materials to the lowest possible basis so as to encourage rather than discourage states and municipalities from undertaking public works. Freight rates on gravel, crushed stone and similar materials should be reduced if possible as well as the excessive demurrage charges on this class of material.

"It is the disposition of the authorities in this city to raise the necessary money for a large amount of public work all that can be carried through.

"The building of an $125,000 high school building is practically assured."

Flint, Mich.

Ezra C. Shoecraft, City Engineer, writes:

"Our 1919 construction program consists of the following, for which money has been appropriated, and which work is now under way:

18 miles of storm, water & sanitary sewers, value	$400,000
8 miles of pavements, value	400,000
500 sq. ft. of sidewalks, value	90,000
Water mains, value	75,600
Total construction cost	$965,600

"The work contemplated to be done, for which appropriation is asked:

Park improvements, which include swimming pools, comfort stations, wading pools, tennis courts, indoor baths, play grounds, etc.	$183,000
1 reinforced concrete bridge	16,000
1 2-arch reinforced concrete bridge	80,000
1 public market building	40,000
1 armory (State has already appropriated $60,000)	140,000
1 fire station	18,000
Total value of work contemplated for which funds are now asked	$477,000

Monroe, Utah

J. Lerue Ogden, Consulting and City Engineer, Monroe, Utah, writes:

"The Richfield City Council some time ago, in response to a very general desire of the citizens to have some street paving work done in the city this year, started investigations regarding costs of the same and at this date have begun actions that will secure for Richfield City a very considerable amount of street pavement before the winter of 1919 sets in.

"They have appointed Mr. H. E. Huddlesen of Salt Lake City as engineer and the following amount of street paving is planned:

"A strip 70 ft. wide is to be laid in the business district for five blocks or about 2,600 lin. ft., a strip 40 ft. wide is contemplated for 3 blocks, or about 1,600 lin. ft., a strip 36 ft. wide is planned for 18 blocks or about 9,000 lin. ft. Also a strip 18 ft. wide is to be laid for about a distance of 3,500 lin. ft., all told making some over 75,000 sq. yds. being contemplated. All of this except the 18 ft. strip is to be enclosed in concrete curb and gutters.

"The City Council appointed April 9, 1919, as a day of election to determine whether the citizens are in favor of bonding the city for the sum of $60,000 to pay for the city's share of the work. At the present time, March 25, the outlook is very bright for an overwhelming victory in favor of the bond issue.

"The payment for the proposed work is to be made as follows: The state of Utah, in compliance with its policy of favoring and aiding work of this kind during the reconstruction period following the great world war, is to pay for an 18 ft. strip throughout the entire city limits on the state road which comprises all but 8 blocks of the work. On these 8 blocks Richfield City will pay for an 18 ft. strip. The remainder will all be assessed against the abutting property holder. Of course the city will pay for all street intersections outside the 18 ft. strip to be paid for by the state.

"The pavement will be either reinforced concrete or bitulithic, which will be decided after the bids from contractors are received.

"The labor situation in the vicinity of Richfield is very good, no considerable surplus being present and therefore this proposition is not the prime mover in the project. However, the city council and citizens feel that it will be an act of patriotism to furnish this labor at a time when such actions are being called for by the U. S. Government to help over the readjustment period, and no doubt surplus labor in other localities will be called upon to aid in the construction, thereby helping the cause of our Government in trying to furnish labor for the returning soldiers."

San Benito County, Calif.

W. A. Winn, County Surveyor, writes:

"We have made plans for improving about six miles of highway with rock macadam at a probable cost of $15,000, and expect to build several concrete culverts during the year, which is about all the permanent work in the county.

"In the town of Hollister they expect to install street lights by the electrolier system for about 3,000 ft. and possibly pave about 4,000 ft. with oil macadam."

Faribault, Minn.

F. W. McKellip, City Engineer, writes:

"The council is in favor of 'buffer' employment and will undoubtedly do considerable construction work later on. At present there is a shortage of labor and this taken in connection with the high price of materials and uncertain weather conditions in this climate at this time of year will tend to retard the construction plans. We feel that the work upon local improvements should be given to local men as far as possible. But a small percentage of local soldiers have returned.

"Petitions have been presented or are being circulated for about 2 miles of storm sewer, 2 miles of curb and gutter, ½ mile of paving. Plans are prepared for a 100-ft. 2-span concrete bridge, besides more than usual in the way of graveling and road construction.

"The building program never looked so promising but high prices are holding back the start. Some one will soon break the ice probably and they'll all fall in. A new bank building is the only one of any considerable size—balance dwellings."

McMinnville, Oregon

Robert W. Jones, City Engineer, writes:

"The construction work that will be undertaken during 1919 under my jurisdiction will be as follows: Hillsboro, Oregon, 25,000 sq. yds. concrete pavement. Amity, Oregon, 20,000 sq. yds. asphaltic pavement. McMinnville, Oregon, probably 20,000 sq. yds. pavement. Yamhill, Oregon, gravity water system, 6 miles pipe line and concrete reservoir, which will cost about $35,000.

De Queen, Ark.

L. G. Ferrel, City Engineer writes:

"There will be built 6 highways in this county aggregating about 100 miles of gravel highway at a cost of one-half million dollars. These districts have already been organized. One contract was let on March 27, and the others will be ready to let before May 1. Sewer district No. 2 will be built in the city of De Queen in the coming fall and winter at a cost of $25,000 and the water works system will be extended at a cost of $5,000."

Lynn, Mass.

W. L. Vennard, City Engineer, writes:

"Three large concrete storm drains together with necessary changes in present combining system of sewerage will be constructed this year in Lynn. This work will probably cost together with some pipe sewers and house drains $126,000. The large sewers will probably be done by contract. We are to build in addition to the sewers about $176,000 worth of paved streets, some of which will be concrete, others will be of asphalt and tarvia."

Du Page County, Illinois

Arthur L. Webster, County Engineer, Wheaton, Ill., writes:

"At a meeting yesterday, (March 22) the commissioners of the Buffalo Grove Drainage District, of Cook and Lake counties (Wm. Kirchhoff of Mt. Prospect is chairman) agreed to proceed with the work, which involves 25 miles of tile, 6 to 30 ins. in diameter, and three miles of open ditches. It will cost in the neighborhood of $150,000.

"The commissioners of Coon Creek Drainage District, (Albert McCue, Sec'y.) will sometime this summer let contracts for the balance of their work, which will consist of about 7 miles of tile work, 6 to 27 ins. in diameter, costing in the neighborhood of $30,000. In addition there will be two bridges to build, valued at about $7,000.

"The Rockford-Winnebago Drainage District of Rockford, Ill., (Wm. Jamison Rockford, Ill., chairman) expect to complete their work, consisting of nearly two miles of additional tile, 8 to 24 ins., in diameter. The contract for open ditch outlet and 30 in. tile awarded to Millard Carr of Marengo, Ill., and now under construction.

"The Wauconda Drainage District, Wauconda, Ill. (commis-

sioners not yet appointed), consists of about 4,000 acres and will be both tile and open ditch and will cost in the neighborhood of $50,000.

"The Wayne-Winfield Drainage District, (Edward Plane of Elgin, Ill., chairman) expect to start spreading the assessment for a drainage district to cost in the neighborhood of $15,000, requiring tile up to 24 ins. in diameter.

"There are a number of similar projects which are more than likely to be constructed this year.

"I firmly believe that it is the duty of all men in charge of construction work to do all in their power to see that work progresses without delay. Nothing will do more to quiet the unrest of the country than to get the wheels of progress in motion, and I feel that my class of work is of more than usual value, as it immediately increases production. I have employed two returning soldiers who were in my employ before the war, and I am paying each of them $25 more than before the war. I have lost one of my best men, a lieutenant, who will stay in the service with the sanitary engineering department of the army."

Brainerd, Minn.

R. T. Campbell, City Engineer, writes:

"It is my pleasure to inform you that the city of Brainerd, under the jurisdiction of its Water and Light Board, has practically completed plans for an entirely new water system. These plans were made by Mr. L. P. Wolff, Consulting Engineer, St. Paul, Minn. The cost of this improvement will amount to practically $250,000, and, as it is a bond issue and the vote of the people of the city of Brainerd is necessary, the outlook for the favorable passage of this bond issue is very good.

"Some street paving is in view, but as our streets will be pretty much torn up during the necessary construction work of the water system, I believe that it will be rather late in the summer before any paving will be done.

"The county of Crow Wing, of which Brainerd is the county seat, is now preparing plans for the construction of a new court house which will cost $200,000.

"With this amount of work in view, it is conceded that Brainerd will be quite busy this coming season with work of a public nature."

Plainfield, N. J.

A. J. Gavett, City Surveyor and Street Commissioner, writes:

"It is not definitely known what street improvements will be made this year, but there is a probability that three-quarters of a mile of concrete pavement, 18 ft. wide, will be constructed, also about 1¼ miles of brick pavement. In this connection there will probably be a number of storm sewers required, from 15 to 36 ins.; probable cost of storm sewers, $40,000."

Sedalia, Mo.

F. T. Leaming, City Engineer, writes:

"We are now at work on a district sewer to cost $8,000; contracts for brick paving already let (work started April 1), $50,000; brick and concrete paving contemplated, $30,000; sidewalks and curbing, $10,000; total, $98,000.

"This city will call an election in the very near future to vote a bond issue of $30,000 or more to construct a modern incinerator or destructor. The Special Rock Road District Commissioners will soon advertise for bids for the resurfacing of 7 miles with crushed rock and asphalt binder. Approximate cost, $65,000. This is a state aid contract. The Mayor and Council of this city are doing all in their power to create work and keep labor employed during the readjustment period."

Youngstown, Ohio

Ett S. Smith, County Surveyor, Mahoning County, Youngstown, Ohio, writes:

"I am in hopes the labor situation in this community will be a great deal better this year than it has been in the last two or three years. The scarcity of labor has been a great handicap, and on that account much important work has been delayed up to this time. The outlook now is very encouraging and we are preparing for a large year's work, including 30 miles of new road construction, 28 miles of reconstruction and about 125 miles of surface treatment. We have already awarded the contract for 100 miles of surface treatment work and 8 miles of new construction, and are ready to advertise for bids for several more miles. Owing to the scarcity of contractors we do a large amount of our reconstruction work by force account. Our county owns two trucks, three 10-ton rollers, grader and scarifiers and other necessary equipment, with which we are able to rebuild and maintain quite a large mileage of roads each year. Our different types of construction include brick, concrete, bituminous and waterbound macadam. By surface treating the macadam roads we are able to keep them in a smooth condition. The roads that have very heavy traffic we resurface with brick over the worn macadam, and have found, after several years of experience, that it makes a splendid foundation for brick pavement.

"I hope that all officials who are in charge of building public roads and streets will go to the limit in the year 1919."

Durant, Okla.

L. Varner Stinson, County Surveyor and Highway Engineer of Bryant County, Durant, Okla., writes:

"The City Council, at the regular meeting of March 4, passed resolutions to pave Lost street and all the down-town alleys; this to be brick, on a concrete base, some 10,000 sq. yds. A petition is now being circulated, and at this writing seems to have a majority of property owners signed, requesting the Mayor and City Council to take the necessary steps to pave Evergreen street with rock asphalt on concrete, about 10,000 sq. yds. Elm street and Eighth avenue property owners will pave, but it has not been definitely decided with what class of paving. This will make the total yardage to come up in the immediate future something like 40,000 sq. yds. There are three or four more streets upon which the sentiment for paving is strong. All told, Durant will start the necessary proceedings to pave some 40,000 to 100,000 sq. yds. of street within the next year."

Columbia, S. C.

T. Keith Legare, City Engineer, writes:

"No definite plans have been made for our construction work during this year, but if the finances can be arranged it is proposed to pave four streets, amounting to $135,000, and construct a municipal abattoir and a market, costing approximately $115,000, also storm drains, costing approximately $8,000. This work has not been ordered by the City Council yet, but we hope that the matter will be settled at an early date."

Sioux City, Iowa

T. H. Johnson, City Engineer, writes:

"It is too early yet to give much of an idea what will be done here.

"We have no new work definitely outlined. We will probably do paving to the amount of $150,000; water works extension, $100,000; sewers, $40,000; bridges, $15,000.

"This may be very considerably increased, but at present writing there is nothing definite."

Rochester, Minn.

J. C. Utton, City Engineer, writes:

"Several projects were temporarily postponed during the period of the war, which we now anticipate will be resumed this year. We are preparing plans for from 50,000 to 60,000 sq. yds. of pavement, and one, possibly two, bridges, which we are confident will be carried through. With the cost of materials higher than in the pre-war period, there will no doubt be some hesitancy upon the part of the property holders in encouraging building. Admitting that the buying capacity of the dollar of today has declined, it is only by investment that it brings business, and good business means prosperity, which is what is needed at this time to promote optimism for the

future and to provide employment for the deserving unemployed."

Madison, S. Dak.

"Charles A. Trimmer, Consulting Engineer, writes:

"We have carried over from last year the following work: Lake Moody County joint ditch No. 1, total cost approximately $150,000, work about 50 percent complete; Lake County ditch No. 6, total cost approximately $40,000, work about 30 percent complete; Lake County ditch No. 12, total cost about $40,000, work about 75 percent complete.

"Since January 1 we have let contract for one job, Lake County ditch No. 20, to cost about $7,000.

"On March 24 we will open bids for storm and sanitary sewers for the city of Madison, estimated cost $37,000, and on March 25 will open bids for Lake County ditch No. 15, estimated cost $55,000. We also expect to open bids in the near future on Lake County ditch No. 13, estimated cost $140,000.

"Contract will also be let this year for about 50,000 sq. yds. of paving in the city of Madison.

"Petitions are being circulated for two additional county drainage jobs to cost approximately $20,000 and $40,000, which work will probably be ready for bids about July 1."

Grand Rapids, Wis.

A. T. Thompson, City Engineer, writes:

"Proposed construction work for the city of Grand Rapids for the season of 1919 is as follows:

"Reinforced concrete on Lincoln and Fifth streets, 5,730 sq. yds; reinforced concrete on Eighth street, 5,224 sq. yds.; reinforced concrete on Oak street, 8,516 sq. yds.; reinforced concrete on Third avenue, 5,294 sq. yds.; brick on concrete base on Grand avenue, 4,800 sq. yds., and approximately one mile of sewer laterals will be constructed this season."

Spencer, Iowa

"W. L. Fahey, City Engineer and Engineer of Clay County, writes:

"Spencer is going to do its share during the period of readjustment and has mapped out a comprehensive program toward that end. Plans and specifications are now being prepared for about 6½ miles of paving and the necessary curbing, guttering and other incidentals. Plans and specifications are also being drawn for sewers to cost about $40,000 and water mains to cost about $10,000.

Considerations Affecting Design of Heavy Traffic Highways in Ontario

By W. A. McLean, Deputy Minister of Highways, Toronto, Ontario

The motor truck as a means of transportation has come into recent prominence through its use for war purposes, through its application to freight transfer between adjacent cities and towns and over routes from 50 to 150 miles in length. Indications are many that, coupled with roads of adequate strength, the motor truck will become an ever increasing factor in this regard. Giving evidence before the Railway Commission of Canada in regard to freight rates, it was recently stated by railway officials that the influence of motor trucks on local freight adjacent to large cities is very great; that in certain cases steam railways now receive very little local freight within a radius of 50 miles from large cities having systems of good roads adjacent to them, as it is handled by motor trucks.

Motor Traffic Leads to Stronger Highways

Just as railways were compelled to use heavier rails and increased strength of roadbed to carry heavier trains and engines of the Mogul type, so will it become necessary to build stronger highways to serve the traffic of heavy motor trucks, particularly on main lines between cities and radiating from large centers of population. The wear from comparatively light and rapid traffic of passenger vehicles is first apparent on the road surface. Heavy trucks, on the other hand, while requiring durable surfaces, demand proportionately durable foundations. Heavy motor traffic has a shattering effect on weak foundations. The depth and strength of foundation is a primary consideration in providing roads which will give the motor truck freedom to enter the field of freight transfer to the extent to which it is economically possible.

The cost of constructing roads is largely in proportion to the depth of stone required. The necessary depth of stone will depend largely upon the character of the sub-soil over which the road is laid—the safe bearing pressure of the soil; and upon the maximum weight of loaded trucks permitted to use the road. The maximum weight of truck is a controllable factor, and should be fixed by regulation.

With unlimited funds, roads can be built which will sustain unrestricted traffic. But funds available are limited, and it is therefore necessary that reasonable standards be fixed and strictly enforced; and that roads be then designed for these conditions.

A reasonable maximum weight of truck should be determined; one which will serve the greater proportion of commercial needs. It is not good business judgment to spend large sums to build roads to the standard of a few trucks of excessive capacity. Trucks of excessive capacity should be prohibited. And regulation is particularly desirable with respect to roads of minor importance, and at seasons of the year when all roads are weakened by moisture and frost.

Bearing Pressures of Soils

Dealing with roads of the broken-stone or macadam type, the maximum load which a road should carry depends in the first instance on the strength of the sub-soil. There is much variation in the supporting strength of different soils, and under different conditions of moisture and climate. Thus "clay" may vary from hard-pan to clay loam; and a dry clay will support a much heavier load than when wet.

Safe bearing pressures of different soils have been determined in a general way for masonry structures. Expreimental investigation with special reference to road surfaces would no doubt develop useful data; but in the absence of more direct information, the bearing pressures adopted for the present purpose are those of the general Bridge Specifications of this department, viz., gravel, 8 tons per sq. ft.; compact sand or firm clay, 4 tons per sq. ft.; clay moderately dry, 2 tons per sq. ft.; wet clay, 1 ton per sq. ft.; quicksand or wet, yielding soil, ½ ton per sq. ft.

The Road Foundation

A concentrated wheel-load is carried downward through a broken stone crust to the sub-soil, at an angle which, it is estimated, diverges outward at about 30 degrees from the vertical. Thus, the effect of the "macadam" crust is to distribute the wheel-load over a greater area of sub-soil; this area increasing with the depth of the stone crust. The depth of stone in excess of the layer needed for immediate surface wear is therefore regarded as the road "foundation." It is the layer of stone artificially laid over the natural sub-soil to the depth necessary to sustain an unyielding surface.

Weight of Vehicles

The maximum weight of vehicles (apart from the well recognized influence on bridges) thus largely determines the depth of foundation necessary on a given road—the depth of foundation varying also according to the nature of the sub-soil, and particularly in northern climates, the season of the year during which heavy vehicles may use the road. The constant passing of many light vehicles will, it is true, influence the foundation, and to meet this condition a certain "mass" is required; but a very few heavy vehicles may shatter an insufficient foundation and thus destroy the entire construction. It is necessary, therefore, that the engineer should know whether the maximum load is to be 6 tons, 10 tons, 15 tons, or 20 tons; particularly the maximum load concentrated on

one axle or one wheel; and also the width of tire on which the maximum load is concentrated.

Commonly, a motor truck, itself weighing 5 tons, can carry a load of 7 tons, making 12 tons in all. Two-thirds, or 8 tons is on the rear axle; one half of that load, or 4 tons, is on each rear wheel. The disruptive effect of this load on roads of light construction is very great—particularly in wet seasons.

Steam trucks, with steel tires, in some cases corrugated, are now in occasional use. As an instance, a 5-ton steam wagon in running order with fuel and water weighs about 6 tons, 10 cwt., with about 2 tons, 15 cwt. on the front axle and 3 tons, 15 cwt. on the back axle. Practically all the load would come on the back wheels, so that when loaded with 5 tons the actual weight on the back axle would be 8 tons, 15 cwt., or over 4 tons, 7 cwt. on each rear wheel. Motor trucks carrying 15 tons and weighing in all about 30 tons, are being manufactured.

Military experience will probably indicate the most desirable type and weight of truck for future industrial purposes. The great majority of trucks used by the French armies weigh 3½ tons empty, and 7 to 8 tons loaded. This standard, applied to road construction generally, would effect a great saving in cost as compared with the maximum of 15 or 20 tons which unrestricted loading will involve. If miiltary preparedness demands provision for heavy artillery loading of 20 tons (and the tendency is still upward) a more moderate standard should be enforced with respect to the great network of purely agricultural and industrial roads which cannot be so built without imposing an unnecessary financial burden.

Thickness of Road Crust

The accompanying schedule, see Table I, is drawn up with a view to the traffic law of Ontario, which permits a maximum load of 12 tons, or 4½ tons on one wheel; and a maximum pressure of 650 lbs. per in. width of tire. The general assumptions are: That two-thirds of the weight of the vehicle and its load will be carried on the rear axles; that wheel pressure is transmitted downward at an angle of 30 degrees from the vertical; that the various types of sub-soil will safely carry the pressure indicated at the head of each column; that the road crust is solely of broken stone or macadam construction.

From this schedule it is evident that 12 tons is the maximum load which can be carried without producing an excessive tire pressure; that there is little difficulty in providing for a 12-ton load on gravel, compact sand, or firm clay; that clay only moderately dry requires a crust approximately 10 ins. in thickness; that 12 ins. will take care of a 6-ton load on wet clay; but that 16 ins. would be required for a load of 12 tons (a condition which could probably be taken care of by a Telford base and broken stone surface having a total depth of 12 ins.). In the case of quicksand and wet, yielding soil, it is evident that special drainage or other special construction is necessary to meet the needs of any but a light load.

As clay is a soil which has very largely to be considered, its drainage and climatic conditions are evidently important factors, as indicated by the difference in depth of crust requred by a moderately dry clay and one which is wet.

TABLE I—REQUIRED THICKNESS OF MACADAM ROAD CRUST TO TRANSMIT AT AN ANGLE OF 30 DEGREES FROM THE VERTICAL, SAFE BEARING PRESSURES TO SUBGRADES OF VARIOUS SOILS

650 lbs. per inch width of tire up to 12-in. tire.
Depth of stone in inches

Weight on vehicle, tons	Weight on rear wheel, tons	Width of tire, inches	Gravel, 8 tons per sq. ft.	Compact sand or firm clay, 4 tons per sq. ft.	Clay moderately dry, 2 tons pounds	Weight per inch width of tire, per sq. ft.	Wet clay, 1 ton per sq. ft.	Quicksand or wet, yielding soil, ½ ton per sq. ft.
3	1	3.07	650	2.33	3.74	5.98	9.05	13.40
6	2	6.15	650	2.63	4.87	7.92	12.25	18.30
9	3	9.21	650	3.16	5.65	9.20	14.40	21.80
10	3 1/3	10.25	650	3.23	6.10	9.60	16.20	24.80
12	4	12.00	666	3.46	6.10	9.60	16.20	24.80
15	5	12.00	833	4.20	7.26	12.00	18.60	28.20
18	6	12.00	1000	4.90	8.26	13.50	20.82	31.50
21	7	12.00	1166	5.48	9.20	14.65	22.50	34.60

Shearing Forces

Self-propelled gasoline motor and steam trucks, in addition to their heavy concentrated load affecting the foundation, have the further disadvantage of exerting a strong shearing force transmitted to the road surface by the driving wheels, so that their use demands not only a heavy and expensive foundation, but an especially durable surface as well. Legislation limiting extraordinary traffic of this description is justifiable, in order that a large increase in the cost of roads may not be necessary to serve the requirements of a few vehicles. Such limitation at the present time forestalls the introduction of unnecessarily heavy vehicles, and avoids cases of individual hardship. Width of tire alone will not solve the difficulty, as, owing to the necessary camber of the road surface, excessive width places the load on the edge of the tire. Should investigation justify it, a less weight than that now permitted in Ontario would be most desirable in the interest of road maintenance.

While limiting loads for Ontario have been fixed as previously stated, it will be desirable to observe carefully the future trend of commercial traffic in order that, if possible, the maximum load may be still further reduced. In 1917 there were registered in Ontario 4,929 motor trucks. Of these, nearly 75% were classed as one-ton or less; over 97% were 3½ ton or less, or within the general military truck standard; while less than 3% were 4-ton and upwards.

A considerable increase in motor truck traffic appears probable after the close of the war. At the present time in Ontario 1 vehicle in 17 is a commercial vehicle; while in the eastern manufacturing states, 1 vehicle in 6 is a truck. Growth of motor truck traffic to the latter proportion will undoubtedly create the need for stronger foundations, particularly on interurban highways; and over certain qualities of sub-soil the use of concrete in place of ordinary broken stone or Telford base, is strongly indicated.

The foregoing data and discussion are from the 1917 annual report of the Ontario Department of Highways.

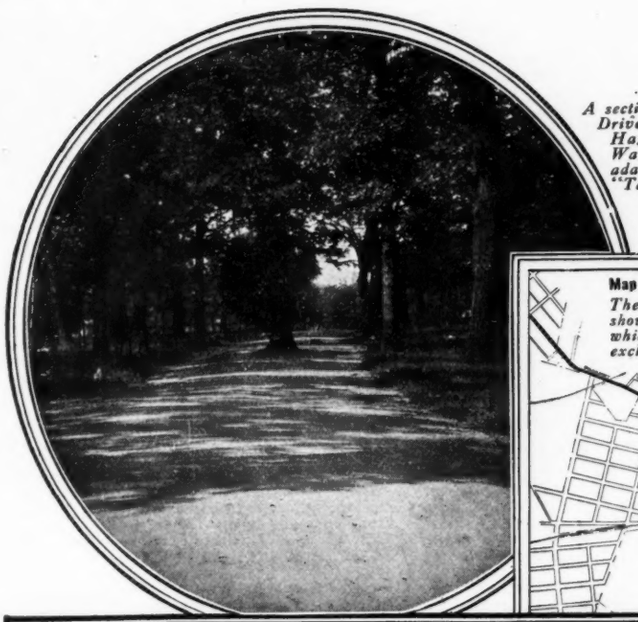
Tamping Cheaply With Home-Made Compressor Outfit

In order to save the cost of a new air compressor, at $500 or more, the San Francisco-Oakland Terminal Railways decided to rig up an outfit, using some old railway compressors.

The idea was carried out by mounting a battery of six 11-cu. ft. capacity pumps on a truck.

The actual capacity required for the two Ingersoll-Rand tampers used is only 32 cu. ft., but double capacity was installed because the old machines were not good for continuous service at more than 50 per cent. loading. These tampers have proved particularly successful in tamping heavy special work. On this railway the machines have allowed six men to do the work which formerly required sixteen. Of the six men one is stationed to flag vehicles while another handles the connection to the trolley wire, leaving the remaining four to do the tamping.

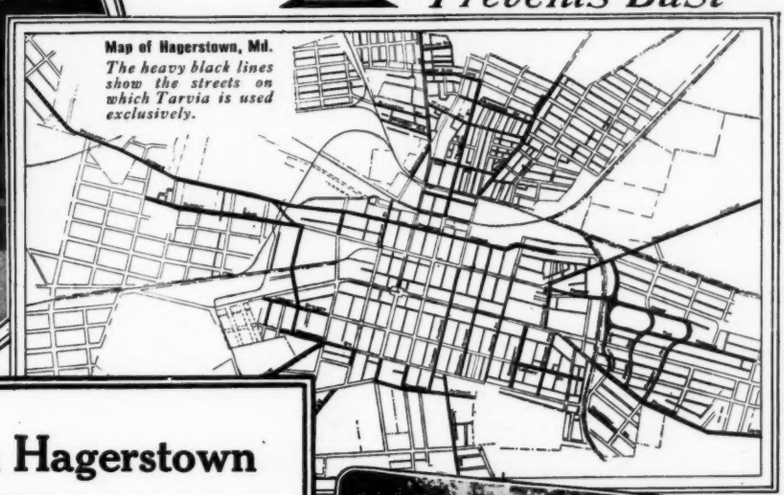
With labor at $2.50 a day the relative costs are: Air tamping, $15; hand tamping, $40; a saving of $25 a day. The tampers paid for themselves in ten days. These tampers are also used for flat tamping of ballast in advance of concreting. They are fitted with chisels when wanted for clipping concrete and cutters when used in stripping asphalt.



A section of "Upper Drive," City Park, Hagerstown, Md. Waterbound macadam treated with "Tarvia-B."

Tarvia

Preserves Roads Prevents Dust



Map of Hagerstown, Md.
The heavy black lines show the streets on which Tarvia is used exclusively.

Tarvia makes good in Hagerstown

These beautiful streets and roads in Hagerstown are macadam, treated with Tarvia to prevent dust and preserve the surface from the destructive effect of automobile traffic.

The use of Tarvia has saved money and has given the city an outfit of fine, smooth, durable streets.

On December 11, 1918, the President of the Board of Street Commissioners wrote us as follows:

> "About five years ago the City of Hagerstown began the use of Tarvia, rebuilding and resurfacing the macadam streets of the town. At first the street commissioners were somewhat dubious about the merits of Tarvia, but the results the first year were so good that each year after that consumption of Tarvia increased until the present time we are using that material exclusively, and our principal macadam streets are in first-class condition.
>
> "Our streets have to stand very heavy automobile and truck traffic and we are convinced they would not do so without the use of Tarvia. (Signed) Chas. A. Ritchey."

Such is the verdict *after five years experience* with Tarvia.

Hagerstown is still another "Tarvia Town," i. e., a town that tarviates all its principal streets and roads as a matter of permanent policy. There are many such towns and counties.

Today the Nation needs good roads more than ever before. The war has emphasized the importance of public highways. They are an integral part of our transportation facilities and have shown their value in supplementing the railroads.

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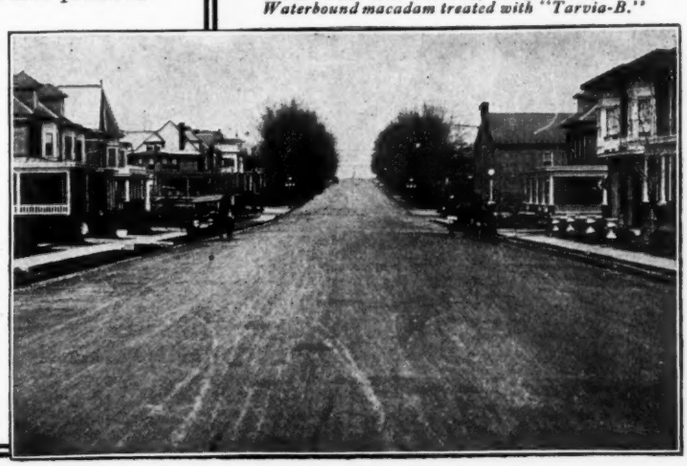
Above—another section of "Upper Drive," City Park, Hagerstown, Md. Waterbound macadam treated with "Tarvia-B."

Below—Oak Hill Avenue, Hagerstown, Md. Waterbound macadam treated with "Tarvia-B."



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CONTRACTS AWARDED

ROADS AND STREETS

Ala,, Athens—Merrill Road Improvement Co., Chattanooga, Tenn., awarded contract by City for street improvements (brick work and storm sewers); Alabama Asphalt Construction Co., 723 Jefferson County Bank Bldg., Birmingham, Ala., contract for treated and plain macadam. Total cost of improvements 260,000. Work includes brk. on conc. base; public sq. and 1 blk. each way; main sts., treated macadam; balance plain macadam.

Ark., Danville—Plumer & Adams, Springfield, Mo., awarded contract by Yell Co., Rd. Dist. No. 1, for preliminary work in Road District No. 1 at 95,000.

Ark., Little Rock—Brown & Foley, Little Rock, awarded contract to lay 22½ miles of gravel road in Monroe County.

Ark., Walnut Ridge—Sam Woodsmall, Shirley, Ark., awarded contract for bldg. 24 miles of road in Van Buren Co., at $100,000.

Cal., Fresno—Thompson Bros. Company, awarded contract for paving Kern St. betw. F and D streets, with 4-in. concrete base and bithulithic wearing surface; J. A. Manning awarded contract for paving Inyo street—betw. G and E streets with 4-in. concrete and bithulithic wearing surface; both contracts at 22c per sq. yd.; Thompson Bros. Company also awarded contract for grading and oiling Trinity street—Kearney avenue to Devisadero street; California Road & Street Improvement Co., awarded contract for paving alley in Block No. 343, at 22.31c sq. ft.

Cal., Los Angeles—Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg, Los Angeles, awarded contract for grading and paving and constructing cement curb, gutter and sidewalks, storm drains and sanitary sewers in Second Street betw. Harbour Blvd. and Pacific Ave.; also portions of other streets in Second street improvement district, San Pedro, Wm. Liddington, 420 East Sixtieth St., Los Angeles, awarded contract for improving Milton Ave., betw. De Longpre avenue and a point 357 ft. south, involving 9984 sq. ft. grading at 1.9c sq. ft.; 9984 sq. ft. oiling and rolling at 4c sq. ft.; 38 lin. ft. cement curb at 45c ft.; 1504 sq. ft. cement walks at 14½c sq. ft.; and 1422 sq. ft. concrete gutter at 19½c sq. ft. Total amount of contract 1101.55; Wm. Liddington, 420 E. 60th St., Los A. also awarded contract for constructing concrete gutters and granite blk. gutters in St. Andrews Place so. of Hollywood Boulevard, involving 2,182 sq. ft. concrete gutter at 21c sq. ft. and 272 sq. ft. granite block gutter at 45.7 sq. ft.—total $582.52

Cal., Los Angeles—W. F. Peck, 4568 Finley Ave., awarded contract by E. Firth, 346 Broadway, Los A., for curbing, guttering and bldg. walks on sts. in Tract No. 3064 west of Main street betw. 89th and 108 streets, at about $20,000.

Cal., Sacramento—C. H. Hudson, Marsh-Strong Bldg., Los Angeles, awarded contract for grading abt. 8.9 miles state highway in San Luis Obispo Co., betw. one mile n.e. of Shandon Pump'g Sta., and easterly bound—at $73,872.

Cal., Sacramento—O. G. Ritchie, P. O. Box 304, Niles, awarded contract for constructing 15.2 miles state hwy., to be graded and paved for length of 11.4 miles with concrete, San Diego County betw. Tecate Divide and the easterly boundary, at $233,273.

Cal., San Diego—Geo. R. Daley, McNeece Bldg., San Diego, awarded contr. for grading and paving Park Blvd., betw. north side of Balboa Park and University Ave., at $50,889.

Cal., San Diego—David H. Ryan, 101 Broadway, San Diego, awarded contract for grading and paving approx. 3½ miles of road on main coast route betw. La Jolla and Pacific Beach, consisting of 11,380 lin. ft., 20 ft. wide, 5-in. concrete with oil and rock screenings wearing surface, at $89,246.

Cal., San Jose—John Doyle, local, awarded contract for grading and paving Almaden road in Santa Clara county at $68,447.

Fla., Madison—W. H. Thomas, Monticello, Fla., awarded contr. by Madison Co. Commrs., & State Hwy Dept., to construct 5.6 mi. State Rd. No. 1—Jefferson Co. line to Greenvilie—at $19,528.

Fla., Tallahassee—W. H. Thomas, Monticello, awarded contract for bldg. 5.6 miles State Rd. No. 1, Madison Co., betw, Jefferson Co. line and town of Greenville, 16 ft. wide at $19,528.

Fla., Tallahassee—Dawkins Constr. Co., Florida Life Bldg., Jacksonville, awarded contract by State College for Women, for paving 1,500 lin. ft., drive way, at abt. $13,800.

Fla., Miami—Bowers Southern Dredging Co., Miami, awarded contract to construct and fill in streets through sub-division 750 ft. long; 650 ft. wide project including seawall, at $50,000.

Fla., Moore Haven—Freedlund Constr. Co., 8th St., and River, Miami, Fla., awarded contract by City to pave various streets and install sewers, at abt. $30,000.

Ga., Atlanta—Nichols Constr. Co., Trust Company of Georgia Bldg., award. contract by Comrs. Fulton Co., for bldg, macadam pavement on So. Moreland Ave.,—Confederate Ave., to Paper Mills Road—at about $26,000.

Ill., E. St. Louis—L. Rich Constr. Co., 429 Missouri Ave., awarded cont. by City for paving 1500 ft. State St.,—33rd to 38th streets; conc. and brick, 42 ft wide, at $27,208.

Ind., Greencastle—O. J. Larkin Coatesville, Ind., awarded contract for constructing 11,873 ft, gravel rd., in Russell and Clinton Twps., 10,634 ft. gravel road in Floyd Twp., 4,800 ft. macad. rd, in Greencastle Twp., and 12,778 ft. macad. rd. Jefferson Twp., and 1,138 ft. macad. rod., Mill Crk. Twp., at $28,000.

Ind., Indianapolis—M. Sapirie Co., Indianapolis Ave., Indianapolis, awarded contract for grading, paving and bldg. bridges on 13,640 ft. McAlpine Road, 20 ft. wide, at $106,245.

Ind., Martinsville—Harris Construction Co., awarded contract for brick road in Washington Twp., by Commrs., Morgan Co., at $81,298.

Ind., Noblesville—T. E. Ramsen, awarded contract for constructing road in Washington Twp., at $11,333; C. W. Edwards, contr. for road in White River Twp., Hamilton Co., at $2,645.

Ind., Rensselaer—Johnson & Hindsley, Medaryville, Ind., awarded contr. for constructing the Joseph Kosta et al. gravel road, Union Twp., Jasper Co., at $10,499.

Ind., Wabash—J. C. O'Connor & Son, Delphi, Ind., awarded contract for constructing roads in Liberty Twp., at $10,845; Todd & Catkins, LaGro, Ind., awarded contract for road in LaGro Co., at $19,641.

Ind., Winchester—Jno. Heitzman, Union City, Ind., awarded contract for constructing 7,295 ft. Campbell Stone road in Green Twp., at $10,170, also 13,953 ft. Parker road in Nettle Creek Twp., at $13,75e.

Iowa, Mason City—Ford Paving Co., will be awarded contract for abt. 57,000 sq. yds. bithu. paving, at $3.34 per sq. yd. by City Council of Tama, Ia.

Kans., Hutchinson—M. M. Bocker, West Hutchinson, awarded contract for graveling, etc., on 3.5 miles of Plum St.

Kans., Oswego—W. C. Juksch Constr. Co., Sapulpa, Okla., awarded contract for Sec. "A", Fed. Aid. Proj. No. 2, Labette Co., for furnishing rein. conc. culvert pipe for farm entrance culverts at $81,087 per mile; Elliott & Vance Constr. Co., Parsons, Kans., awarded contract for Sect. "B" for furnishing conc. culvert pipe for farm entrance culverts at $112,135.

Ky., Bowling Green—R. G. Price, Bowling Green, awarded contract by Commrs. Warren Co., for resurfacing 5.7 miles macadam roads; base price $1.75 per ton for first mile of haul.

La., Columbia—C. A. Reese, City, awarded contract for constructing 15 mi. graveled hwy., at approx. $65,000.

La., Columbia—C. A. Reese, Columbia, awarded contract to construct 15 mi. graveled highway, at $65,000.

Md., Elkridge—Howard Frior, 1707 W. Pratt St., Baltimore, awarded contr. to straighten Dead Man's Curve on Washinton Blvd.,—2½ miles from here.

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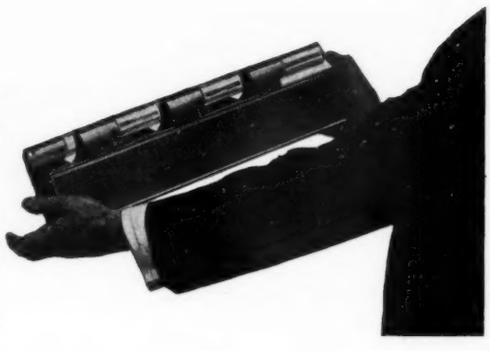

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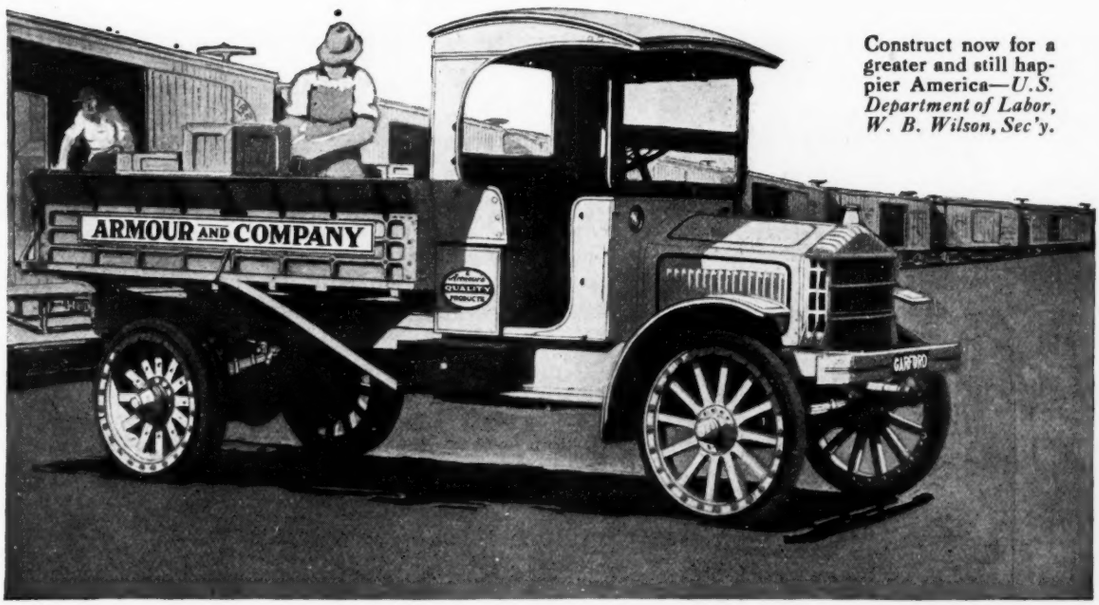

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Mich., Mt. Clemens—Detroit Asphalt Paving Co., awarded contract for constructing about 11 miles of road (sheet asph. surface on conc. base) at $543,140.

Minn., Aitkin—Stevens Bros., McGregor, awarded contract by Commrs., Aitkin Co., for surfacing 6,780 cu. yds. State Rd. No. 1, at $14,815.

Minn., Alexandria—S. J. Groves & Son, Kasota Bldg., Minneapolis, awarded contract for grading and gravel surfacing for Fed. Aid Project No. 27, State Rd. No. 1; 16 miles, at $95,656; Concrete Products Co., Elk River, Minn., awarded contract for concrete culverts for state aid portion Project 1904; 3 miles, at $2,208; Morris Construction Co., Morris, Minn., awarded contr. for 2 monolithic culverts, at $1,248. Plans with Co. Aud. Vernon J. Thomas, County Aud.

Miss., Sumner—Newell Construction Co. 2209-2211 First Ave., Birmingham, awarded contract for 21-5-10 miles of graveling and surfacing with bitum., material, at $79,235.

Mo., Caruthersville—W. D. Lonergan, St. Louis, Missouri, awarded contract by City to construct 8,600 sq. yds. vibrolithic pavement.

Mo. Harrisonville—Nichols & Hadkins, Belton, Mo., awarded contract to construct roads by Cass County, at $9,841.

Mo., Kansas City—C. G. Brosnahan, 5122 Grand Ave., awarded contract for 2,-043 sq. yds. bitum, macadam paving at $169,569.

Mo., Kansas City—City let contracts for for paving as follows: Gray Paving & Material Co., Jackson Avenue, Harrison and Washington Sts.; Foxhall P. McCormick, Broadway, Holly St., section of Harrison street; E. D. Tyner Construction Co., Myrtle and Elmwood Aves.; J. C. Lyle, Jackson Ave.; all of Kansas City; sheet asph., asph.-conc. and vertical fibre brick.

Mo., Kansas City—A. R. Mense, awarded contract to pave sections of 7th and Grand Ave., with brick.

Mo., Kansas City—William Harte, awarded contract for paving Twelfth street—Broadway to Troost avenue—at approx. $50,000. Specfs. call for an 8-in. concrete base with paving of vertical fibre brk., and an asphaltic filler.

Mo., St. Louis—Carl Tritt, Belleville, Ohio, awarded contract for grading Belleville-Hecker road, at $33,994; also Belleville-Millstadt road, at $15,922.

Neb., Lexington—Omaha Concrete Steel Bridge Co., Omaha, awarded contr. for paving Dist. No. 1; 3,525 lin. ft. curb, 2,670 lin. ft. drain boxes, 24 manholes from drain boxes, at $80,894.

Neb., Grand Island—Watts Constr. Co., Concordia, Kans., awarded contract for curbing and paving with sheet asphalt 756 ft. Koenig, Lincoln and Cleburn streets. 3 ft. wide, at about $86,259.

N. Y., Albany—C. Kiehn, 26 Gardner Bldg., Utica, awarded contract for bldg. certain parts of approach from Court St. and South Ave. to Barge Canal Terminal at Rochester, at $120,598.

N. Y., New Rochelle—Tony Miele, awarded contract for road betw. Beachmont Lake and Woods of Larchmont, at $6,950.

N. Y., New York—Following contracts awarded by M. E. Connelly, Pres. Queens Boro: Sicilian Asph. Paving Co., regulating, grading, curbing, laying walks and paving Hancock St., Wyckoff Ave., to Evergreen branch of Long Isl. R. R., at $5,448; C. Gallagher, 124th St.—Metropolitan to Jamaica Aves., $9,595; 123rd St., $13,863; Grimm Contg. Co., 12th St., Jamaica to 89th Aves., at $5,042; R. A. Hess, Elmhurst, L. I., portion of 150th St., at $826; portion of Armand Pl., at $1,276; McCarthy, Rush & Ryan, E. Trenton Ave., portion of Barclay Ave., $592, Delaware Ave., $298, 153rd St., at $1,250, Gates Ave., $1,040; E. W. Fitzpatrick, 244 Jackson Ave., Long Island City, portion Emerson St.; Peace Bros., 200 Main St., Flushing portion of 102nd street, at $300.

N. C., Asheville—Asheville Constr. Co., City, awarded contract for grading section of Henderson Road—Arden to County line—at approx. $8,000.

N. C., Boone—J. F. Mulligan, City, awarded contract for constructing 100 miles surfaced road in Watauga Co., at approx. $200,000.

N. D., Cando—Russell Grader Mfg. Co., 2037 University Ave., S. E., Minneapolis, awarded contract for all road culverts for one year.

N. D., Bismarck—Larkin Construction Co., Barry, Minn., awarded contract to grade and build culverts on 31.5 miles of road north and west through Forman Twp., Sargent Co., by State Hwy. Comm., at $54,-370.

N. D. Bismarck—Stanley Bros., Glenfield awarded contract by State Hwy. Comn., for bldg. 16 miles State Aid Project No. 1,672—West from Glenfield in Foster Co., at $18,288.

O., Batavia—John Gaul, Owensville, O., awarded contract for constructing 6,600 ft. of pike on Maple-Goodwin road, Tate Twp., including constr. of 12-ft. bridge and extending a few culverts involving 800 yds. excav., etc., at $4,900.

Ohio, Cleveland—Following contracts let by City for paving and grading; Freshwater Constr. Co., 9703 Madison Ave., (grading & paving 7,500 sq. yds. Denison Ave., 5-in. brick blk. on 5-in. conc. base) at $51,345; Roehl Bros., W. 25th St. & Clark Ave., (20,000 sq. yds. Roehl Ave., 4-in. brk blk. on 4-in. conc. base, at $9,-680;) Riley Bros., 384 Arcade, (paving & curbing 15,600 sq. yds. Flora Ave., 5-in. brk. blk. on 5-in. conc. base, involving 1,100 cu. ft. Berea sandstone curbing) at $7,068; Enterprise Paving Co., 8436 Broadway (paving 20,000 sq. yds. Aetna Rd., 4-in. brk. blk. on 6-in. conc. base) at $10,-000; Gould & Maybach, 323 E. 105th St., (repairing 16,400 sq. yds. E. 128th St., 5-in. brk. block on 6-in. conc. base).

Ohio, Cleveland—Roehl Bros., awarded contract for grading, repaving and improving W. 7th St., Railway avenue, S. W., to Novak Ave., S. W.—at $2,922; also Novak Ave., S. W.,—W. 7th St., to W. 5th St., at $2,030.

Ore., Astoria—Montague O'Reilly Co., awarded contract for paving seaside highway—west end of cutoff road to Methodist Church at Warrenton—abt. 3,630 ft., at $17,796.

Ore., Astoria—J. H. Tillman Co., awarded contract for grading and paving remaining portion of Smith's Point Road, with asph. concrete, at $28,592.

Oregon, Portland—State Highway Commission awarded contracts for eight projects as follows: H. J. Hildeburn, contr. for grading 5.1 mi. Douglas Co., concrete pipe, at $49,107; Jno. Hampshire, Grants Pass, Ore., grading 2.1 mi. Douglas Co., conc. pipe, through Stage Coach Pass, at $53,220; Elliott & Scoggins, Portland, grading, macadam 4 mi. Yamhill-Nestuc, using corrugated iron pipe, mat. $57,917; A. Guthrie & Co., Portland, 11.3 miles paving, Hillsboro to Multnomah Co. line, No. 1 conc., gravel, at $248,935; A. Anderson, Grant's Pass, Ore., reinf. conc. viaduct at Divide, $6,256; Oskar Huber, Portland, 10.5 mi. paving West Side Hwy., Benton Co.,—Corvallis to Polk county line, type "F" pavement, at $224,260, (State Hwy Commission will do the grading, etc., leaving only surfacing to this contr. Bid of Huber's on this job was $248,649.50); S. S. Schell, Grant's Pass, Ore., 6.1 miles paving Josephine Co., type "D" pavement, at $118,717. Contract for grading and macadam of 30 miles in Morrow county was not awarded as a whole. Porter & Conley, secured portion of highway, being stations 00-790 and 730 to 420. Their bid of $226,-020 for entire project will probably be reduced to abt. $100,000 for this portion of the work; balance of project will be carried on by force account.

Okla., Tulsa—C. O. & H. Frye, City, awarded contract for constructing concrete road and 3 miles additional road to Rose Hill cemetery, at $181,445.

Pa., Pittsburgh—M. O.Herron & Co., 1st & McKeen Sts., awarded contract by

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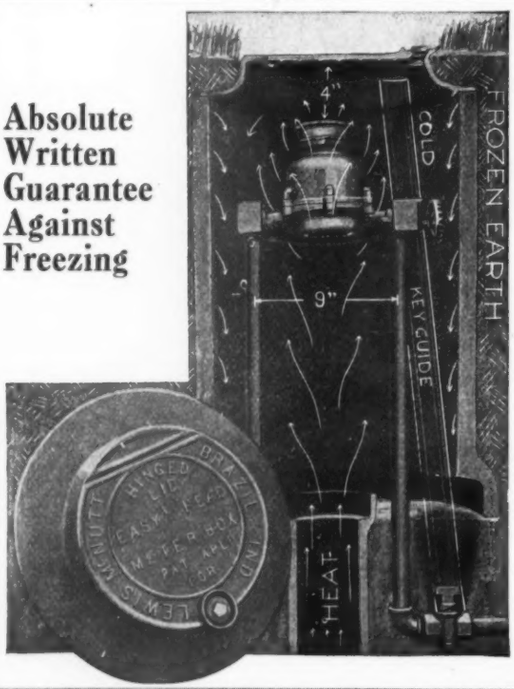

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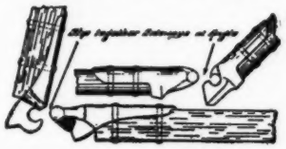

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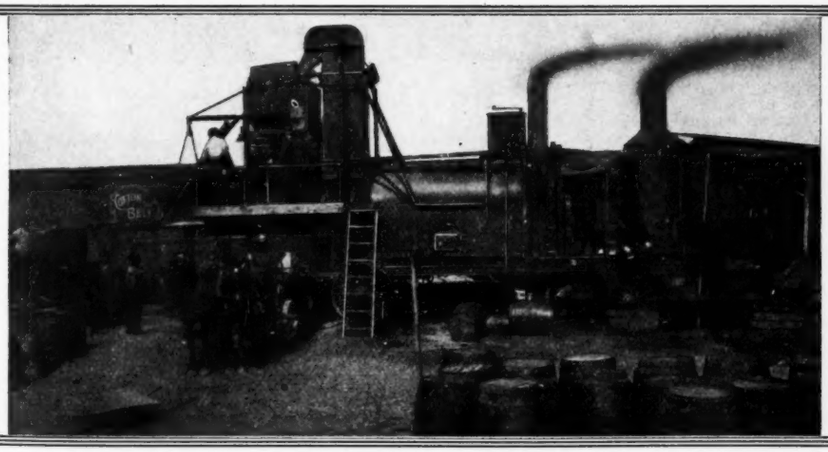

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PHILADELPHIA

Chartiers Twp., for grading, paving, curbing 958 ft. Middletown Rd.—Ladoga street to Ashtola Alley, 30 ft. wide, at $19,272.

S. C., Spartanburg—Following contracts awarded by Spartanburg Co. Hwy. Comn. Southern Paving Constr. Co., Chattanooga, Tenn., 2 mi. of Appalachian Hwy & 1.9 mi. Cedar Springs Rd., both with asph.-conc., at abt. $105,000; J. F. Blakenship & Son, 9 mi. top-soiling on Blackstock Rd., at $40,000; Thompson & Chandler, to grade & top-soil 7 mi. Blackstock and 3 miles of Woodruff Ridge road, at abt. $45,000.

Tenn., Jonesboro—Foy & Proctor, Nashville, Tenn., awarded contract for constructing 21.35 miles State Hwy. No. 2, Washington Co., betw. Green and Carter Co. line, involving 260,432 sq. yds. waterbound macad. surfacing; 200,432 sq. yds. broken stone, base course and 73,000 cu. yds. excavation, at $22,443.

Tenn., Nashville—Foy-Proctor Co., City, awarded contract for constructing Dixie Hwy. through Washington Co., extending entirely across county thru Johnson City. approx. 21.35 miles long, at approx. $227,-000. Work also includes number of conc. bridges, four of which are more than 20 ft. in length.

W. Va., Fayetteville—Tony Petro, Morgantown, W. Va., awarded contract to construct 10 miles of road in Sewell Mountain Dist., at $44,707; also 3 miles in Nuttall Dist., at $35,505.

SEWERAGE AND SEWAGE TREATMENT

Ala., Athens—Merrill Road Improvement Co., Chattanooga, Tenn., awarded contract by city for storm sewer construction, in connection with brick street improvements.

Ala., Florence—C. G. Kershaw, Woodward Bldg., Birmingham, awarded contr., for bldg. 10 miles of sewers in various streets, at about $100,000.

Cal., Chino—Fleming Constr. Co., Pomona, awarded contract for constructing approx. 1,650 lin. ft. 8-in. san. sewer in alley betw. F and C. streets, at $1,389.

Cal., Seal Beach—Miagenovich & Gillespie, 219 Bloom street, Los Angeles, submitted only bid and will probably be awarded contract for constructing sewer system and disposal works, at about $42,-000. There will be an Imhoff tank, 24x20 ft. of reinf. conc., a pumping plant with rotary plant and electric motor with automatic control; also 2 auxiliary booster pumps.

Conn., Bridgeport—Dambrosio and Delbalzo Co., 84 Silver Lane, East Hartford, awarded contract by City for bldg. combined tile sewer in East Washington Avenue and Main street, at $13,950.

Fla., Moore Haven—Freedlund Constr. Co., 8th street and River, Miami, Fla., awarded contract to construct and pave various streets; $30,000 available.

Fla., St. Petersburg—Southern Construction Company, St. Petersburg, awarded contract for bldg. two 1- sty. septic tank units and installing 15,410 ft. sanitary sewers in alleys betw. 9th and 10th Aves., N. 10th & 11th Aves., N. 11th and 12th Aves., N. and 12th and to 13th Aves., N. from 4th St. to Bay, at $21,395.

Ill., Springfield—John O. Patterson & Co., City, awarded contract for bldg. Washington Park sewer, at $8,500.

Ind., Terre Haute—P. O. Leary awarded contract for laying sewer pipe in Poplar street, at about $18,000.

Ia., Tama—Dearborn Construction Co., Waterloo, Ia., awarded contract for constr. of storm sewers, 600 ft. 15 in. pipe at $1.15; 900 ft 12-in. at 97c; 3,185 ft. 10-in. at 89c.

Mass., Boston—James Barletto awarded contract for sewerage works in Gerrish street, Brighton, at $3,997; A. Baruffaldi, contract for sewerage works in Hyde Park avenue and across land of Commonwealth of Mass., at $5,040.

Mich., Ford Village—Geo. R. Cooke, Detroit, Mich., awarded contract for extending and completing sewer systems in Ford Village at $101,887.

Mich., Wyandotte—Geo. R. Cooke, 1260 Penobscot Bldg., Detroit, awarded contract for laying sewer pipes, to include trenching, back filling, sanitary sewer system, extension of present storm water sewer, sewage pumping plants and all appurts., at $111,729.

Mo., St. Louis—Following contracts for constructing sewers awarded by Bd. of Public Service: No. 356: Oakland Ave., Sewer Dist. No. 2, Bates & Martin, at $15,028; No. 857: Arloe Sewer Dist. No. 1, Geo. G. Pendergast Constr., Co., $52,522; No. 858: Arloe Sewer Dist. No. 2, Bates & Martin, $9,689.

N. J., Phillipsburg—Korp & Korp, 611 S. Main St., Phillipsburg, awarded contract for storm sewer in S. Main St., (contract No. 5), at $7,674.

N. Y., Albany—Murphy Bros., 262 Bay St., Brooklyn, awarded contract for constructing sewage disposal plant at Creedmoor, at $22,483.

N. Y., Creedmore—Murphy Bros., 262 Bay 43rd St., Brooklyn, awarded contr. by State Hosp. Comn., Albany, for bldg. sewage disposal plant, at Brooklyn State Hosp., at $22,483. Plans include installation of Imhoff tanks, six 10-in. syphons, dosing chambers, 6 beds, diverting manhole, 1,000 ft. 12-in. vitr. pipe, etc.

N. Y., Syracuse—J. Young, Bastable Block, awarded contract for bldg. Divs. 3, 4, & 5, Onondago Creek Impvt., and main intercepting sewer, at $543,327. Project includes 2 miles creek improvement and 1.3 miles intercepting sewer, and involves 111,500 cu. yds. excav., and 18,000 cu. yds. concrete.

L. I., Rockaway—Rangely Construction Co., 405 Lexington Ave., New York City, awarded contract for constructing addition to sewer system at navy yards here, at $14,840.

N. C., Durham—S. N. Slade, Durham, awarded contract to construct Alston Ave. sewage outfall plant, at $15,162; also to construct sewers, requiring 2,760 lin. ft. 8-in. pipe on Main and other streets, at $18,744; G. R. Lassiter Co., Oxford, N. C., awarded contract to construct Neuse River sewage outfall plant, at $21,326.

O. Bexley—E. C. Bartling, 734 So. Champion Ave., City, awarded contr. for furnishing material and constructing 1,700 ft. 8-in. vitr. pipe sanitary sewer, 3 manholes, etc., at $4,400.

O. Cleveland—N. Salem, awarded contract for constr. of sewer in E. 160th St., Calcutta Ave., N. E. to Waterloo road, N. E., at $1,638; the Walter P. Gibbons Contracting Co., awarded contract for constructing sewer in Yorick Ave., N. E., Ivanhoe Rd. N. E. to 850 ft. east of easterly end, at $2,735; A. H. Hattendorf & Co., awarded contract for construction of sewers in following streets: E. 159th St., Holmes Ave. N. E. to Saranac Rd., at approx. $3,296; E. 157th St., Holmes Ave., N. E. to Saranac Rd., N. E., approx. $2,-489; E. 155th St., Holmes Ave. N. E. to Saranac Rd., N. E. approx. $1,286; E. 156th St., Holmes Ave. N. E. to Saranac Rd., N. E., approx. $2,014; E. 160th St., Holmes to Saranac, approx. $3,697; Assad Aftoora and Albert Joseph awarded contract for construction of sewer in E 157th St., Waterloo Rd. N. E. to Calcutta Ave., N. E., at $1,434; Dan Pfahl & Co. awarded contract for constructing sewers in E. 158th St., Calcutta Ave. N. E., to Waterloo Rd., N. E., at approx. $1,539; and E. 156th St., Waterloo Rd., N. E., to Daniel Ave., N. E., approx. $5,378; Wm. McDowell & Son Co., awarded contract for constructing sewer in E. 30th St. betw. Scovill Ave. S. E., and Cedar Ave. S. E., at $58,947.

Ohio, Columbus—Following contracts for constructing sewers awarded by Director Public Service: Ames Bros., I. O. Jones and L. B. Wilkinson, Columbus, Ohio, Donnelly, McKeon & Stevens Co., Cleveland.

Ohio, Hamilton—Jno. L. Walker Co., awarded contract for construction of sanitary sewers in East Hamilton Sewer District No. 3 at $14,000.

Ohio, Massilon—Hahn Bros., Canton, awarded contract for constr. of san. sewer in Fay street at $1,068.

Ohio, Toledo—Peters Bros., awarded contract by Serv. Director Goodwillis for constructing sewer No. 1,335 in Gorny's addition, at $3,286.

Utah, Provo—Mullings & Palm, Salt Lake City, awarded contract for extension to sewer in Dist. No. 7, at $2,175.

Utah, Salt Lake City—Ryberg Bros., Salt Lake City, awarded contract for constructing sewers on 11th avenue and D St., at $1,082.

Va., Petersburg—Thurston & Co., Richmond, awarded contract to construct concrete flume for Brick House Run, at $17,-830.

Wis., Milwaukee—Klugg & Smith Co., Mack Block, Milwaukee, awarded contract for grit chamber and effluent conduit at $85,000.

Wash., Bremerton—S. A. Moceri, Seattle, awarded contract for constructing McKenzie, Warren and Cogean Ave. sewer at $4,802.

WATER SUPPLY AND PURIFICATION

Cal., Los Angeles—E. Firth, 346 South Broadway, city, will install by day labor pump and wood tank and lay 3 miles 2-6 in. O. D. pipe in tract at 99th, 100th, Main and Figueroa streets.

Cal., Covina—J. L. Ackland, 618 So. Kingsley Drive, Los Angeles, awarded contract for constructing rein-conc. cylindrical reservoir near here for L. J. Grimmesey, at $5,088.

Ind., Auburn — Following contracts awarded by City Council: Worthington Pump and Machinery Co., contr. for air compressor and tank, at $2,250; H. H. Achemire, city, contr. for construction of reservoir at $1,968; Indiana Air Pump Co., Indianapolis, contract for 5 air lift pumps at $600.

Ind., East Chicago—Warner Construction Co., Chicago, Ill., awarded contract for bldg. water filtration plant here at $333,-000. It will have 6 filt. units, each with cap. of 1 1-3 million gallons every 24 hrs. capy. 8,000,000 gals. a day. Plant will be built to permit extension to capy. of 16,-000,000 gals. It will have a sediment basin with capy. of 1,500,000 gals. Chemical and filter houses will be built and extension made to boiler house; also an addition to pumping house.

Ia. Waukon—Thorpe Bros. awarded contract at Perry for new deep well at $1,-022.50.

Ky., Dawson Springs—Railroad, Water & Coal Hauling Co., 608 S. Dearborn St., Chicago, awarded contract by Ill. Central R. R. Co., to construct water works and pump house at $30,000.

Md., Brunswick—H. C. Brooks Co., Martinsburg, W. Va., awarded contr. to construct water system; lay 5 miles 4 to 10-in. wood stave pipe from springs in Loudoun Co., Va.; gravity flow; also enlarge and improve reservoir. Norton, Bird & Whitman, Engrs., 1320 Munsey Bldg., Baltimore.

Minn., Biwabik—Lawrence McCann Co., 407 Pierce St., Eveleth, Minn., awarded contract for ditch and laying pipe for new water supply at Embarrass Lake, at $6,780.

Miss., Oxford—Carlos Wells & Supply Co., Memphis, Tenn., awarded contract for constructing and equipping 122-in. well, pump strain and all ready to pump, at $3,200.

Neb., Bayard—Gordon Construction Co., Denver, Colo., awarded contract for extension of water mains and main sewer, at $60,000.

Neb., Maywood—Roy Cashler awarded contract for well.

O. Cincinnati—Jno. Strong, Cleves, Ohio, awarded contract for constructing new concrete bridge No. 11 on Sand Run Road No. 17, Whitewater Twp., at $1,560.

Ohio, Cleveland — Baker-Dunbar-Allen Co., 1900 Euclid Bldg., awarded contract for laying water and steam pipes, to $6,448.

O., Maple Heights—W. B. Smith, 10933 Detroit Ave., Cleveland, awarded contract for bldg. water pipe line in Dunham Rd. and Orchard Ave., at $5,381. Work involves 2,600 ft. 6-in. steel pipe.

Pa., Ft. Mifflin—Pittsburgh-Des Moines Steel Co., New York City, awarded contract for constructing steel water tank and tower at $6,755.

Pa., Ft. Mifflin—M. & J. B. McHugh, 892 N. Market St., Philadelphia, Pa., awarded contract for constructing fresh water pipe line at navy yard here at $38,877.

R. I., East Providence—Wilmarth Mackillop, Inc., Freeman street, Pawtucket, awarded contract by Amer. Electrical Works for bldg. 1 sty., 20x25 ft. steel and rein. conc. pump house, conc. foundation and 30-in.x310 ft. rein. conc. intake pipe, at about $30,000.

W. Va., Clarksburg—American Water Softener Co., 1011 Chestnut St., Phila., Pa., awarded contract to install addition of 3,000,000 gals. daily capy. to filtration plant.

BRIDGES AND BUILDINGS

Ariz., Bisbee—El Paso Bridge & Iron Co., El Paso, Texas, awarded contr. for constr. of rein. conc. bridge over Silver Creek, 13 miles east of Douglas, Cochise county; Chiado & Correll, Warren, Ariz., awarded contract for constructing bridges and culverts on Sect. 1, Douglas-East highways; Jas. B. Smith, Lowell, awarded contract for constructing bridges and dips on Pearce-Servoss-Cochise highway.

Cal., Sacramento—Mercer-Fraser Company, Eureka, awarded contract for construction of timber drawbridge with concrete trestle approaches—about 712 ft. long at Eureka slough, Humboldt Co., at $61,999.

Washington, D. C.—C. Thompkins, 1883 Third street, N. W., awarded contract by Commissioners of District for bldg. concrete encased steel plate girder bridge on South Dakota avenue, over tracks of Baltimore and Ohio R. R., (work complete) at $32,400.

Ga., Royston—Wade A. Watson awarded contract by Beaverdam Creek Draing. Dist. Commrs., for constructing canal 12 to 16 ft. bottom 8½ miles long, at $35,000.

Idaho, Wallace—Security Bridge Co. awarded contract for constr. of new steel bridge across Coeur d'Alene river at Cataldo at $29,000.

Ill., Carlinville—Herrick Construction Company, city, awarded contract for constructing one rein. conc. bridge in Shipment Twp., known as the Oraw bridge, 16-ft. span, 16-ft roadway, 11½-ft height over all, involving 50.8 cu. yds. concrete and 4,210 lbs. rein. steel; M. C. Robinson, Girard, Ill., awarded contract for constructing one rein. conc. bridge in No. Otter Twp., known as Cable bridge, 22 ft. span, 18- ft. roadway, height over all 14 ft., involving 76.8 cu. yds. concrete and 7,400 lbs. reinf. steel.

Ill—Benton—Parkam Constr. Co., E. St. Louis, Ill., awarded contr. for constructing reinf. conc. bridge in Barren Twp., Franklin Co., known as Quillman bridge, at $2,424.

Ill., Benton—B. F. Clark & Son, St. Louis, Mo., awarded contract for bldg, reinf. conc. bridge in Benton Twp., Franklin Co., known as Martin Bridge, at $1,450.

Ill., Crete—H. C. Wieland, Monee, awarded contract for reinf. conc. bridge in Crete Twp., Will county, at $4,870.

Ill., Springfield—Claude L. James, Mattoon, Ill., awarded contract for Pine Hook bridge in Richland Twp., Shelby county, at $2,512.

Ill., Springfield—B. F. Clark & Sons, St. Louis, Mo., awarded contract for constr. of Locker bridge, Union Twp., Cumberland Co., at $2,100.

Ind., Boonville—L. J. Utley, Mt. Vernon, awarded contract for constr. of 19 steel bridges at $21,800.

Ind., Bluffton—Jas. A. Crosbie, local, awarded contract by Commrs. for 21 bridges and bridge repair jobs at $21,785.

Ind., Logansport—Girten & Perry, Logansport, Ind., awarded contract for constructing concrete arch bridge, 40-ft. span, 65-ft. rdway at $8,485.

Ind., Petersburg—Following contracts awarded by Pike County Commrs ; Alonzo Corn, repairing Wm. Laswell bridge No. 121, at $159; B. F. English, bridge No. 141, at $4,105; also bridge No. 140, at $4,785; also repair contr. No. 132 at $316 and No. 130 at $200.

Ind., Rushville—Lawrence & Ennis, Arlington, awarded contract for construction of 3 bridges at $1,724, $790 and $470; Burke Construction Co., awarded contract for one bridge at $6,850.

Ia., Jefferson—R. E. Shackelton, Perry, awarded contract for 2 bridges in Paton Twp., on Sects. 31 and 30, at $5,700 and $2,499, respectively; F. E Marsh Co., local contr. for brdg. Willow Twp., at $4,050 and one in Greenbrier at $3,090.

Kans., Hays City—Central Bridge Co., Mankato, Kans., awarded contract for constructing Ellis Golden Belt bridge at $4,912.

Kans., Hiawatha—Following contracts awarded by Brown County for bridge construction: Missouri Valley Bridge & Iron Company given contracts for bridges: Gidden bridge, Hiawatha Twp., at $1,003; Ed Chase bridge Padonia Twp., at $3,344; Kale bridge, Mission Twp., at $5,133; Jim Chase bridge, Hiawatha Twp., at $2,142; Henney bridge, Mission Twp., at $1,574; E. H. Snyder & Son, contract for Schuetz bridge, Mission Twp , at $2,095; Mrs. Lena Opfer, contracts for following: Hamlin bridge, Hamlin Twp., at $1,385; Powhatan bridge, Powhatan Twp., $1,925; Stewart bridge betw. Padonia and Hamlin Twps., at $1,241.

Kans., Kansas City—Patterson Constr. Co., city, awarded contract for building new rein. conc. bridge over Brush Crk. at Ward Parkway and Holly St., at $8,250.

Kans., Topeka—C. C. Clark & Co., 202 Evelyn St., Topeka, awarded cont. for constructing one 48-ft. span rein. conc. arch brdg. over Butcher Cr. at 21st street, at $10,686.

Kansas, Topeka—N. T. Hopkins awarded contract by city for building 90-ft rein. concrete bridge over Shunganunga Creek on 8th street, cantilever sidewalks, 20-ft. roadway and 5- ft. sidewalks; also 100 ft. bridge over Shunganunga Creek on 4th street, 20-ft roadway, 5-ft. sidewalks at $21,993 and $21,998, respectively.

Kans., Wichita—Smith-Graham Co., Augusta, awarded contract for conc. rd., and 41 bridges and culverts at $208,583; Missouri Valley Bridge & Iron Co , Leavenworth, awarded contract for 6 bridges at $17,383.

Mich., Charlotte—Zimmer & Quickgraf, Mason, awarded contract for bridge over the Thornapple river on No. Main street road, several miles north of here, at $6,426. New bridge will be of steel and cement.

Mich., Charlotte—Wolverine Engrg. Co., Mason, Mich. awarded contract for furnishing material and constructing 50-ft. span, 18-ft. rdway, reinf. conc. girder brdg. over Thornapple Crk., at $6,427.

Mich., Lowell—J. C. Harch & A. Lewis city, awarded contracts for bldg. bridge No. 210, north of here, at $11,059.

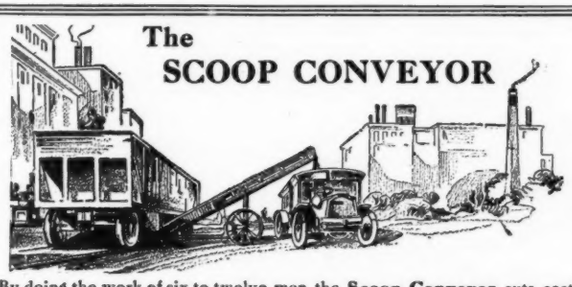
Minn., Motley—Geo. H. Beers awarded contract for repairing bridge No. 3,012 over Crow Wing river, Cass and Morrison counties, at $3,400.

Mo., Kans. City—Patterson Construction Co., Kansas City, awarded contract to construct bridge over Brush Creek at 50th & Holly Stas.; reinf. conc.; 2 32-ft conc. arch spans: 28-ft. rdway, 5-ft. walk, at $9,250.

N. C., Walnut Grove—Virginia Bridge & Iron Co., Roanoke, Va., awarded contract by Stokes County, to construct double steel bridge across Taun Fork at Walnut Grove.

O., Columbus—Harden & Moran awarded contr. by State Hwy. Dept., for conc. bridge at $20,524.

O. Marion—Grant Boulton, Columbus, Ohio, awarded contract for constr. of bridge over the Tymochtee creek in Grand Twp., on La-Rue-Marseilles pike, at $7,671; E. O'Brine, La Rue, awarded contract for construction of bridge over Tymochtee



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creek, Grand Twp., near H. J. Lower home, at $4,093.

O., Marion—J. D. Gillespie awarded contract for erecting sub-structure of bridge over Tymochtee creek at $3,885.

Okla., Guymon—Missouri Valley Bridge & Iron Works, 4th & Walnut Sts., Leavenworth, Kans., awarded contract by Texas county for bldg. one 240-ft and one 120-ft. brdg.; also 1 small bridge at $13,349.

Ore., Coquille—Ellingson & A. N. Gould, Coquille, awarded contract by Coos County Commrs. for constr. of China Camp bridge at abt. $9,500.

Pa., Laceyville—Whitaker & Diehl, Union Trust Bldg., Harrisburg, awarded contract for bldg. bridge here at about $36,-715.

S. D., Rapid City—Rush Bros. awarded contract for construction of bridge across Rapid river, at Oshkosh street.

Tex., Houston—J. H. Johnson, R. F. D., Central Park, Houston, awarded contract for concrete bridge at $2,985.

Va., Bedford—R. A. Figgatt, 312 Terry Bldg., Roanoke, awarded contract for concrete bridge in Bedford county at $6,000.

Wash., Ceres—N. C. Sears, Winlock, awarded contract by Lewis county for bldg. 160-ft. conc. Howe truss bridge, at about $10,087.

Wash., Tacoma—Following contracts were awarded for bridge construction: C. F. Bergstrom & Son, Fife-Milton bridge, at $1,560; D. W. Rutherford, McMillan bridge at $9,875; also to same contractor the Marshall Ave. bridge at $940.

W. Va., Buckhannon—Corns-Thomas Engrg. Co., Huntington, W. Va., awarded contract for furnishing material and constructing reinf. conc. arch brdg. across Buckhannon river at Our's Mill, at $7,991.

W. Va., Lewisburg—Concrete Steel Bridge Co., Clarksburg, W. Va., awarded contract for bldg. concrete bridge over Wades Creek on James River and Kanawha Pike, one mile east of White and Sulphur Springs, at $1,998.

Wyo., Sheridan—Monarch Engineering Co., Falls City, Nebraska, awarded contract for construction of big steel bridge over Big Goose at junction of stream with Beaver Creek, at $3,210, estimated cost, although part of the cost will depend upon amount of work required.

DRAINAGE AND IRRIGATION

Ark., Jonesboro—A. V. Wills, St. Louis, Mo., awarded contract to constr. drainage system by Cache River Drainage District; 22 miles drainage canal and 12 miles laterals in Craighead, Lawrence and Jackson conties, $529,000.

Ark., Lonoke—O. Kochtizky, Cape Girardeau, Mo., awarded contract by Bayou Metropolitan Drainage District No. 1, Lonoke Co., for dredging in Bayou channel, with laterals draining into bayou and clearing right-of-old channel to be 50-ft base, laterals 6-16 ft. base, at $.10½ cu. yds. for bayou work, $.30 cu. yd. team work and laterals and $27 an acre for clearing.

Cal., Covina—J. L. Ackland, 818 South Kingsley Drive, Los Angeles, awarded contract for constructing reinf. concrete cylindrical reservoir near Covina, at $5,088.

Ga., Royston—Wade A. Watson, awarded contract by Beaverdam Creek Drainage Dist. Commrs., for constructing canal 12 to 16-ft bottom, 8 2-3 miles in length, to drain 677 acres of farming, at $35,000.

Ia., Logan—Callahan-Walker Constr. Co., Omaha, awarded contr. for Willow Draing. Dist. No. 2, at 11.32c per cu. yd.; Sect. 1, 504,680 cu. yds. excav.; No. 2, 641 cu. yds.; Sec. 3, 800 cu. yds.; Sec. 4, 335 cu. yds.; Sec. 5, 705 cu. yds. Sec. 6, 1,085 cu. yds.; Sec. 7, 1,425 cu. yds.; 8, 1,660 cu. yds., and Sec. 9, 2,255 cu. yds.

Minn., Ada—Strom, Deggerness & Hanson, Gary, awarded contract by Commrs. of Norman and Clay counties for bldg. Judicial Ditch No. 56, at $.0983 cu. yd., excav., and $275 per lin. mi. leveling. Work involves main ditch and 3 laterals and inclues 914,619 cu. yds. excav., 27 miles road leveling and 32 bridges.

Minn., Fairmont—Nels Myking & W. C. Gilbert, Fairmont, awarded contract for Ditch No. 37, at $1,251.

Minn., Mankato—North Star Concrete Company, Mankato, awarded contract by Blue Earth Company for building Judicial Ditch No. 24 in Blue Earth, Martin and Faribault counties at $66,924.

Minn., St. James—B. Dahl & Co., Madelia, Minn., awarded contr. for constructing Judicial Ditch 26 at $10,279.

Minn., Windom—Cottonwood county—Rude & Wold, Windom, Minn, awarded contract for county ditch No. 11, at $14,959.

Miss, Tunica—Jacob Kohler, Bemidji, Minn., awarded contract by Pritchard Draing. Dist. to construct floating dredge work and small levee work.

N. C., Shelby—Cleveland Co. Comnrs. have $25,000 available to construct rd. in Twp. No. 9; W. P. Eddleman will make survey and supervise construction.

N. C., Walnut Grove—Virginia Bridge & Iron Co., Roanoke, awarded contract by Stokes Co., to construct double-steel bridge across Taun Fork at Walnut Grove.

N. D., Fargo—State Hwy. Dept. announces that it is practically ready to advertise 200 miles of state hwy. projects, amounting to abt. $325,000. Plans also being made for other state hwy. projects, totaling 325 miles, to be let before the summer and to cost approx. $525,000. State Hwy. Dept. expects to supervise constr. of abt. $800,000 worth of work annually for next several yrs., unless through congressional action additional fed. aid will be provided, in which case the Dept. may be called on to supervise expendt. of abt. $2,000,000 annually on state hwy. systems.

O., Cleveland—County Comnrs. have authorized improvements on two more county roads in connection with general improvement plan. 1½ mi. Fitzwater Rd., Brecksville, will be surfaced with waterproof macad at cost of $19,000; $206,000 will be expended for general repairs and paving of 4½ mi. Wilson Mill Rd., Mayfield Twp.

O., Fremont—Ed Bodette, Toledo, awarded contract for constr. of Mud Creek ditch improvement by the three counties of Wood, Seneca and Sandusky, 13 miles long; excav. 149,769 cu. ft. earth, and 14,454 ft. rock, $66,381.

S. C., York—Sigmore Rinehart & Co., Stanley, N. C., awarded contr. for dredging, consist'g of, 26 mi. dredg ditch'g excav'g., etc., at $77,000.

Tenn., Dyersburg—Norfolk Fork Drainage District—A. V. Wills & Sons, Batmens' Bank Bldg., St. Louis, Mo., awarded contract by District for excavation work in connection with completion of clearing abt. 400 acres.

PROSPECTIVE WORK

ROADS AND STREETS

Ala., Huntsville—Plans for improving Alabama-Jackson Hwy., through this section this year, provide for expendt. of $60,-000 betw. Huntsville and New Hope by Madison Co., with the state and federal aid; the expendt. of $30,000 by Marshall Co., on Cottonville road betw. New Hope and Guntersville. It is estimated $200,-000 will be expended on improvements betw. Shelbyville, Tenn., and Gadsden, Ala.

Cal., Alturas—(Modoc County). State Hwy. Department announces that $410,000 and the $210,000 which was allotted several years ago, will be available this spring for road work.

Cal., Redlands—T. E. Norton, Asst. Ch. Engr., Forestry Serv., announces that Fed. aid in the sum of $100,000 will be available for Deer Crk. cutoff on crest road into Bear Valley.

Cal., Riverside—Property owners in Palo Verde Valley will raise $50,000 by direct taxation for constr. of main hwy. between Fertilla and Palo Verde by way of Blythe. $75,000 will be required to complete rd. and county will assist in its construction.

Cal., Sacramento—Committee representing over 250 civic and commercial and municipal organizations, plan election to vote on $35,015,000 bonds; $15,015,000 to be used to grade and pave 1,150 miles new highway and $20,000,000 to complete original hwy. Plans include road—Barstow Needles, $350,000; Oxnard to San Juan Capistrano, $4,000,000; Barstow to Mojave, $150,000; Santa Maria to Bakersfield, $1,000,000; Skyline Blvd., San Francisco to Santa Cruz, $2,471,000; Rio Vista to Fairfield, $384,000; Auburn to Verdi, $1,000,000; Ukiah to Tahoe City, $2,700,000; Crescent City to Oregon line, $400,000; Santa Rosa to Shellville, $450,000; Big Pine to Fasis, $300,000; Placerville to Sportsman Hall, $100,000; Feather River Canyon Rd.—Oroville to Quincy, $85,000; Kings River Canyon Road, $100,000; Calistoga to Lowa Lake, $200,000; Mecca to Blythe, $300,000; Rumsey to Lower Lake, $254,000. A. B. Fletcher, Sacramento, State Hwy. Engr.

Cal., Santa Barbara—City Engr. A. B. Cook, instructed to prepare plans and specfs. for paving E. Mission street bet. Bath and Modoc road pavement; also for improvement of East Montecito street bet. State and Milpas Sts.

Colo., Colorado Springs—Clarence O. Ford, Co. Surv., surveying a stretch of Denver road No. of city which is to be reconstructed and straightened as first fed. paved road proj. in El Paso county.

Fla. Milton—Santa Rosa County and State Rd. Dept., (Wm. F. Cocke, State Rd. Commr.) Tallahassee, will have $190,-000 available to construct 15 mi. State Rd. No. 1; vitr. brk., grouted on sand base, 9 ft. wide with rock shoulders. Date of opening bids not set.

Ga., Fort Valley—City will vote April 30 on $24,000 bonds for street paving; probably construct conc., brk. or macadam. Mayor H. C. Neil contemplates expending abt. $90,000 for paving business streets and walks. If bonds carry bids will be opened abt. June 20th.

Ga., Macon—$1,500,000 bonds voted by Bibb county, including bonds for road construction. J. Ross Bowdre, Clk.

Ga., Staunton—Augusta County Bd. of Spvrs., will improve 13 miles of Covington-Hot Springs Road—Covington to Bath county lines. Est. cost $57,000, of which $28,000 is available from bond issue and $28,800 state aid.

Idaho, Pocatello—Resolution passed by council ordering City Engr. to prepare estimates of cost of paving all streets & alleys for which petitions have been filed.

Idaho, Moscow—Thorn Crk. Hwy. district has voted in favor of forming hwy. district. This is an important link in proposed hwy. to be built from Boundary county to Boise.

Idaho, Caldwell—City will expend $125,-000 for paving two principal street—Kimball Ave., and Cleveland Blvd.

Idaho, Boise—$150,000 bonds voted for bldg. north & south hwy.; 8 mi., will pass through this district (central hwy. district). Projects approved by Fed. government to be undertaken in this state, total 156.33 miles.

Idaho, Idaho Falls—City council adopted resolution providing for about 63,000 sq. yds. of paving, at est. cost of $189,940. It is proposed to push matter as fast as possible so work may begin in 60 days.

Idaho, Pocatello—City plans to expend $459,031 for improvement work on streets and alleys. District will be known as Local Impvt. Dist. No. 23.

Ill., Zion City—Zion City Council has organized Bd. of Local Impvts. First work shall be the impvt. of Sheridan road with a conc. pavement, 18 ft. wide where it leads to business section and 30 ft. wide in the remainder.

Indiana, Indianapolis—Reports from number of counties to State Council of Defense on plans for public bldgs, & hwy. work are as follows: Adams—30 mi. if bonds can be sold. Blackford—6 or 8 mi. macadam. Clay—9 mi. Clark—12 mi. macadam. Delaware—2 mi. gravel & 9,000 lin| ft. macadam. Hancock—14 mi. Howard—6 or 8 mi. Jasper—About 25 mi. rds. & 45 to 50 mi. of ditches. Jay—1 mi. street and 1,000 ft. water mains. Jennings—Several petitions filed for pike roads. Johnson—14 mi. rds. & septic tank for sewage disposal. Madison—Some new streets, considerable resurfacing. Miami—Possibly 6 rds. Montgomery—2 square brick paving; 1 mi. walks. Pike—5 mi. rock rds. Porter—Abt. 20 mi. macadam. Randolph—5 blks. brk. paving. Ripley—Abt. 12 mi. macadam. Sullivan—8 rds, at est. cost $194,-019. Spencer—9 mi. rds. Tipton— 11 mi. improved hwy. Warrick—Not to exceed 10 mi. rock rd. Wells—15 blks. resurfacing. White—13 blocks street paving.

Ia., Mapleton—Preliminary plans in progress for paving approx. 40 blks. during summer. W. E. Standeven, Engr., Bee Bldg., Omaha, Neb.

Kans., Stuttgart—Bill providing for $30,000,000 bond issue for purpose of establishing state highways will be placed before the senate by Senator Chas. A. Walls, Lonoke, Kans.

La., Shreveport—City will construct abt. 80,000 sq. yds. asph. conc. street paving. Date of opening not set. W. F. Thoman, Comnr. Sts. and Parks. Engineer, H. E. Barnes, City Hall.

Me., Augusta—$30,000 has been asked of

Maine legislature for rebldg. hwy. through Wells, Berwick, and North Berwick to New Hampshire line.

Mass., Falmouth—At annual meeting appropriations totaled $235,000; of which $124,000 will be used for hwy. impvts. A boulevard along shore at Falmouth Heights and Menauhaunt will be constructed at abt. $40,000.

Mass., Fitchburg—$6,700 voted for street maintenance; macadam maintenance, $7,500; paving maintenance, $4,000.

Mass., Weymouth—$20,000 voted for macadam roads; $19,000 for highways and bridges.

Mass., Winchester—$51,334 voted for highway and bridge construction.

Mass., Linchendon—$20,450 voted for highway construction.

Mass., New Bedford—$16,000 voted for roads, bridges and walks.

Mass., Easton—$17,000 voted for highways and bridges.

Mich., Allegan—Allegan County Commrs., upon authorization of the fifty million dollar bond issue, will recommend a trunk line project to state hwy dept. Plan is to build cement rd. from W. Michigan pike along the town line betw. Saugatuck and Ganges, via Fennville to Allegan, thence to a junction with the Dixie Hwy. Proposed hwy. is urgent local need.

Minn., Anoka—Anoka county 18 mi. bithu. paving planned; extend through Osseo & connect'g with paving s. e. of Osseo, with paved rd. to be built from Osseo to Champlin. Anoka will also pave from Ferry street to city limits west on Main. Arthur A. Caswell, Aud.

Minn., Duluth—City plans to expend $2,000,000 for paving, curbing and guttering various streets during 1919. Bids will be asked abt. April 1. B. Farrell, St. Commr., L. A. Ayres, City Hall, Engr.

Minn., Minneapolis—City will expend $344,000 for paving within near future. Paving plans approved by Council's Pav'g. Comm. Creo. blk. recut granite and brk. will be materials used.

Minn., Virginia—According to present plans town will spend about $30,000 during summer for street paving impvts. E. F. Johnson, City Engr. There is little doubt that the alleys in each side of Chestnut street will be paved and this work alone will cost abt. $20,000.

Miss., Clarksdale—Coahoma county will grade and surf. 22 miles conc. rd., 9 ft. wide; earth shoulders; has $300,000 available. Will open bids abt. June 1. L. M. Mashburn, Co. Engr.

Miss., Greenville—Washington county votes April 3 on $1,250,000 bonds for constr. of 140 miles of concrete roads; $800,000 available from previous bond issue.

Mo., Rolla—Phelps County Commrs. construct 60 miles state hwy.; dirt and Louisville-Springfield road; graded earth and gravel; width 24 ft. $52,700.

Mo., Van Buren—$125,000 available to construct 60 miles state hwy.; dirt and gravel road. Carter Co. W. L. Skinner, Engr., Van Buren. No bids.

Mont., Helena—Delegates representing Montana Division of Yellowstone Trail Assn. have voted in favor of amendment to S. B. 46 relating to $15,000,000 bond issue for highway improvements.

Neb., Fullerton—Arrangements made for constr. of state highways—Lodgepole to Dalton; Potter to Dalton and Sidney to Bridgeport via Dalton.

N. J., Hoboken—City having revised plans made for paving 4th St., Hudson to River streets; 11th street, Clinton to Madison streets; 14th St., Madison to Jackson streets. Abt. $100,000. J. O. Whittemore, City Engr.

N. J., Newark—Board Comn. will ask Board of Freeholders, Essex County, to issue $605,000 bonds to improve roads. F. A. Reimer, Co. Engr. Bd. of Comrs. Contemplate paving Clinton Ave., W. Newark branch of Penn. R. R. to Chadwick Ave., Springfield Ave., Morris to city line; South street, Pacific St. to New Jersey R. R. Ave., So Orange Ave., Springfield to So. 9th St., Wilson Ave. Ferry to London streets: Sussex Ave., High to Summit Sts. M. R. Sherrard, City Engr.

N. M., Santa Fe—Secy. of Agriculture has given approval to New Mexico fed. aid project No. 13, call. for rd. 28.9 mi. long, in Valencie Co.; also to project No. 14, which allows constr. of rd. 10.66 mi. long in Santa Fe Co. Work on both projects will start soon.

N. Y., Manhattan Boro—$3,000,000 will be expended in repaving streets and constructing sewers. Some of this work must be advertised for contract, but Boro Pres. Frank L. Dowling has in excess of $300,000 worth of this type of work that can be started without a day's delay. This portion represents contracts let last fall for which material could not be secured. At least $1,750,000 worth of repaving work will be undertaken within ten days.

O., Millersburg—Holmes county has extensive road impvt. program planned for this season. Abt. 18 miles will be improved at est. cost of $149,000.

O., Wauseon—Commrs. Ottawa Co. have outlined plan for improving abt. 15 miles of road in county during spring & summer. Est. $480,000.

O., Zanesville—Council has started preliminaries for summer paving program; motion passed for engineer to prepare plans for paving in 4th, 6th and 7th streets in business district; Pine and Sheridan streets, Adair Ave., Blue avenue west to twp. line, Market St., Underwood to Greenwood; State street, Lee to McIntire and W. Muskingum avenue, Pine street to Luck avenue.

Okla., Antlers—$129,000 bonds voted by Pushmataha Co. Commrs., for graded roads in Antlers Twp., Kiamichi Twp., $29,000. Date of opening bids not set. B. C. McCleary, Engr.

Okla., Miami—Plans & Specfs. for paving approx. 40 blocks of streets in city approved by City Comn. Specfs. provide for conc. paving, 10 sts. in central portion of city included in paving district.

Okla., Tulsa—City will pave streets in Broadmoor addition. Est. cost $50,000.

Ore., Astoria—Engr. Hackett, representing State Hwy. Comn., has begun the work of cross-sectioning hwy. for 5 miles of paving from Young's Bay west. Engrg. work will take abt. 2 weeks. It is expected Comn. will let contract at next meeting this month.

Ore., Mount Angel—Joint delegation of Mt. Angel and Scotts Mills road enthusiasts will hold meeting to consider plans for bonding county for hard-surfaced roads, connecting all incorporated cities within county.

Ore., Portland—Pacific Northwest will receive $37,549,976 as grand total for road bldg. from fed. & state funds during next two years, according to figures by Dist. Engr. L. I. Hewes in charge of U. S. Bureau Pub. Rds., in Oregon, Washington, Montana and Idaho. Oregon's total will amt. to about $9,136,888; half from fed. govt. and remainder from state funds for hwy work. Most of the money will be available at once and work will start in abt. 90 days.

Tex., Del Rio—Valverde Co., (J. C. Henry, Judge) plans to build 7 miles tar-via surfacing. Est. cost $45,000.

Tex., Paris—Lamar County voted $1,500,000 bonds for construction of roads. W. H. Hutchison, Co. Judge.

Tex., Rockwall—Rockwall Co. voted $800,000 bonds to construct roads; State Hwy. Comn. will appropriate $100,000; total $900,000. Portion of this sum will be expended for constr. of 13-mile conc. road, 18 ft. wide; Dallas county line to Hunt county line.

Tex., Waco—McLennan county votes April 5 on $3,500,000 bonds for constructing 376 miles of roads.

Utah, Salt Lake City—Program of State Rd. Comn. calls for constr. of 98 mi. hard-surfaced highway in state, at an approx. cost of $2,000,000. Ira R. Browning, State Rd. Engr.

Utah, Salt Lake City—$1,500,000 bonds voted by citizens of Salt Lake County to finance road improvements.

Va., Norfolk—City may expend sum of $760,226 for smooth paving of Monticello Ave. and Boush street.

Va., Portsmouth—$25,000 appropriated by Comn. Rds. & Brdgs., toward construction of concrete road, 16 ft. wide, Portsmouth to Nansemond Co. line, about 5 miles. State Hwy. Comn., Richmond, will appropriate $75,000 addtl.

Va., Richmond—State Hwy. Comn. plans expendt. of abt. $5,000,000 for rd. construction. Geo. P. Coleman, State Hwy. Engr.

Va., Richmond—State Hwy. Comn., (Geo. P. Coleman, Engr.) will build 3 mi. of concrete road betw. Richmond and Petersburg, Width, 18 ft. $70.000.

Va., Rocky Mount—City will macadamize streets; abt. 11¾ miles. Date of opening bids not set; engineer not employed. C. S. Greer, Mayor.

Va., Staunton—Augusta Co. Bd. of Supvrs. will improve 13 mi. Covington-Hot Springs road, betw. Covington and Bath counties line; $57,600, of which $28,800 is available from bond issue and $28,000 state aid.

Wn., Charleston—City will immediately begin paving campaign. Plans under consideration not only call for two paved strets bew. Bremerton and Charleston, when Bremerton has completed Fourth street impvt. now in progress, but will cover paving of part at least of 13 streets in west end section.

Wn., Bellingham—Columbia, Glacier, Maple Falls and Deming Twps. have voted in favor of bond issues totaling nearly $50,000 for graveling and improving Deming-Glacier road. Each Twp. will issue bonds in sum of $13,000.

Wn., Centralia—Survey being made by county engineer's office of 3½ miles of Pacific Hwy., betw. Forest and Toledo, which will be paved this year.

Wn., Seattle—Official approval received by Bd. Co. Comnrs., King Co., by State Hwy. Comnr. Jas. Allen, of resolutions passed by Bd. for impvt. of 6 King Co. road projects as follows: 1—Renton-Issaquah road, 4 mi. 2—Redmond-Hollywood rd., 2 mi. 33—Auburn-Enumclaw (unpaved portion) 2 mi. 4—Seattle-Renton road (unpaved portion so. of Brynn Mawr) 1.3 mi. 5—Houghton-Medina-Bellevue road, ¾ mile pavement and ½ mi. grading & graveling. 6—Kent-Auburn road (unpaved portion) 4.77 mi. long. Plans being rushed to completion and bids will be received in very near future by Bd.

Wash., Yakima—Yakima county planning to expend $1,118,300 for road work during 1919; work to be done under the Donahue road law. 43 miles hard surfaced road being considered.

Wis., Beloit—Rock county will build abt. 30 miles new macadam road and 6 mile-stretch conc. hwy. this summer in addition to repairing and resurfacing abt. 20 miles road. Chas. E. Moore County Hwy. Comnr.

Wis., Racine—City considering following improvements for 1919: Carlisle St., sheet asph.; Osborne St., brk. or conc.; 10th street, asph. conc.; Grange, brk. on conc.; Prospect, brk. on conc.; 17th, brk. on conc.; Albert, brk. on conc.; Howland, asph.-macad.; Yout, brk. on conc.; (2) Milwaukee, brk. & macad.; Asylum, brk. on conc.; Lake Ave., brk. on conc.; Pearl, 11th, Hilker pl. asph. conc.; 7th, brk. on macad.; 8th, asph. concrete. City Engr. P. H. Connelly, City Hall, Racine.

SEWERAGE AND SEWAGE TREATMENT

Ala., Birmingham—City will install sanitary sewer system. Julian Kendrick, city Engr.

Ariz., Holbrook—Agitation for construction of sewer system and municipal water works has been revived. Olmstead & Gillelen, Consit. Engrs., Los Angeles, estimated cost of these impvts., prior to war, at about $100,000.

Cal., Fresno—Resolution adopted by Trustees to construct sewers (6-in laterals) in alleys of Arlington Heights, serving 8 blks.

Cal., Los Angeles—Wm. Mulholland, Ch. Engr., Dept. Pub. Service, 645 So. Olive street, reports that plan to supply aqueduct water to abt. 30,000 acres near Sawtelle & Westgate, annexed to city, is feasible. He recommended constr. of an auxiliary pipe line—San Francisco reservoir across San Fernando Valley to a point near Sawtelle, abt. 25 miles; also a distributing system to supply water for both domestic & irrig. purposes. Roughly estimated cost will be about $1,950,000. Steps already taken by people of district towards organization of irrig district. They will also vote bonds for the work.

Cal., San Diego—Olmsted & Gillelen, Sanitary Engrs., report that present method of sewage disposal is a menace to the city and they recommend that city build intercepting sewers, small pumping station for territory below the interceptors and install treat. plants. Two general plans are recommended: (1) Constr. of separate disp. plant near end of each of the existing outfalls and the other collection of sewer flow, except that from 52nd St. outfall, and installation of single treat. plant in vicinity of Beardsley st. & Railroad Ave., and a small plant near end of 32nd street outfall. Total est. cost $606,500 for the latter plans.

Cal., San Luis Obispo—Council adopted resolution of intention to construct concrete pipe sewers in 5 city streets.

Cal., Seal Beach—$40,000 sewer bond issue has been sold.

Col., Denver—City plans to enlarge 16th street sewer, Lawrence to Welton streets; present 15-in. pipe to be replaced with 1,900 ft. 18-24 in. vitr. pipe. J. B. Hunter, City Engr.

Fla., Leesburg—City will vote April 2nd (change of date) on $35,000 bonds for constructing sanitary sewer and $50,000 bonds to construct storm sewers and improve streets. J. C. Lee, Act'g. Mayor.

Ga., Talbottom—Town is considering construction of sewer system. J. A. Smith Secy.-Treas.

Ill., Batavia—City considering constr. of east side sewerage system. Abt. $140,000.

Ind., Terre Haute—Mayor Hunter announces that as soon as weather permits work will begin construction of Poplar street sewer—19th street to Twp. line. Bids soon to be asked. Also wk. will soon start on constr. of first municipal sewer in northeast part of city.

Ind., Terre Haute—City will expend $32,000 for sewer construction this year. Council has apropriated $98,000 for bldg. sewers and sidewalks, also for paving important streets.

Ind., Berne—Business Men's Assn. decidedly in favor of constructing water works. Town is out of debt and in splendid condition financially. Every member of the association feels that the town is not safe in case of fire, while water supply is so inadequate as at present.

Ia., Anita—Engineers figuring cost of sewerage system; citizens in favor of improvement.

Ia., Burlington—Council voted in favor of establishing two sewers; one to begin at manhole in the Angular street sewer at alley No. 8 and extend no. 245 ft. The other will start at lot 53 in Rand's Adn. on Lucas Ave., extending westerly abt. 200 ft.

Ia., Malvern—City receives bids about April 1st for install. 16,000 to 18,000 ft. 8 and 10 in. sanitary sewers. Archer & Stevens, 609 New England Bldg., Kans. City, Mo., Engrs.

Ia., Roland—Survey and plans ready for sewers. Cost from $35,000 to $40,000. Jeffrey Mickaelson, City Clk.

Ky., Bridgeport—City will build sewers costing $106,900 as follows: Wood & Hillside Aves., $15,500; Island, Brook Ave. and River St., $25,000; combined sewer in W. Washington Ave., $6,300; Spring St., $25,000; storm sewer in Railroad Court Extension, $18,000; sanitary intercepting sewer in Bay St., $17,100. J. B. McElroy, City Engr.

Mass., Reading—State legislature, Boston, petitioned to build sewerage system here. Cost betw. $300,000 and $400,000.

Mich., Lansing—$45,000 sewer proposed by Council Sewer Comn. to take care of that portion of city bounded by Magnolia on the east, Cedar river on the south, Penn. Ave. on the west and Main St. on the north, which includes Potter Park. Proposed sewer and tributaries would be 5 mi. long. Recommendations made to bond city for the work.

Mich., Pontiac—City Comn. passed Ord. to bond city in the sum of $325,000 for installing sewage disp. system. Election will be held.

Mo., Macon—Bids soon to be asked by city (Wm. H. Martin, Clk.) for following: Engine, generator & settling basin; install 400 to 450 K. V. A. unit; construct 50x50 ft. conc. reservoir. $45,000 to be expended by city for power plant, including new unit. Engr. Frank Wilson, Syndicate Trust Bldg., St. Louis, Mo.

Neb., Geneva—City will ask bids in May for bldg. sanitary sewerage system. Bonds for $35,000 voted for project. Grant & Fulton, 505 Bankers Life Bldg., Lincoln, Engrs.

Neb., Lincoln—Election soon to be called for purpose of voting on $100,000 bonds for bldg. sanitary sewer system: First, collecting sewer beginning with san. sewer near 3rd & South streets, etc.; second, collecting sewer commencing at sant. sewer at 27th street near city limits: 3rd, outlets, pumping equipt. & primary unit or units of sewage disp. plant to be located at place in vicinity of intersect. of 9th street and Salt creek.

N. J., Butler—Town having preliminary plans preparing for installing sewerage system.

N. J., Montclair— City plans to construct sewer (storm) in Norwood Ave. Cost betw. $32,000 and $35,000.

N. Y., Endicott—Endicott, Johnson & Co., 753 Bleecker St., Utica, contemplates bldg. sewer to serve tannery; also make other extensions. Approx. cost abt. $200,000.

N. Y., Buffalo—City soon to receive bids for bldg. 2 mi. Sloans Drain, abt. $300,000. Plans include 6-8 ft. trunk sewer for flood relief, brk. segm. blk. or reinf. conc. pipe. G. H. Norton, City Engr.

N. Y., Rochester—City contemplates improving Clifford Ave. Dist.—sanitary and storm sewers. Est. cost $90,000; Chili Ave. outlet sewer, $18,700. A. C. Poole, city Engr.

Ohio, Cleveland—Alex Bernstein, Sewer Director, reports that constr. of the 3 new sewage disposal plants will be started in March at total cost of $1,000,000.

O., Coshocton—Work on new sewerage system covering 88 acres in Co. Coshocton will begin in spring. Resolution passed by council for the work.

O., Hamilton—Ord. passed providing for constr. of storm sewer on Rhea Ave. D street alley to Miami river at est. cost $5,459.

O., Kenmore—New Imhoff tanks and sludge beds to cost abt. $25,000 are needed for Kenmore disposal plant, accord'g to report made by State Engr. Stewart of State Bd. of Health. Complaints have been made that sewage from Kenmore was sweeping into Mud Run and the Tuscarawas River, Barberton.

O., Lima—Plans for the seven big sewers—Collett, Northside, Southside, Lakewood Avenue, Collett lateral, So. Side lateral and North Side laterals reliefs, etc., now ready to be filed by City Engr. Plans for work amount to $1,500,000.

O., Toledo—Service Director Goodwillie will submit to council within a few weeks plans & specfs. for a $4,000,000 intercepting sewer system.

O., Youngstown—Resolution adopted declaring it necessary to construct sewers in seven different streets in city. M. F. Hyland, Clk. of council; J. N. Higley, Pres.

Okla., Bixby—$85,000 bonds voted by city to construct sewerage and water systems.

Pa., Elmwood City—City plans to issue bonds in sum of $18,000 to build sewers in various streets.

Pa., Philadelphia—Ch. Albright, of Bureau of Surveys will urge council to appropriate $50,000 for completion of Cobb's Crk. sewer. Numerous complains received from residents of 69th and Market streets section.

Pa., Pittsburgh— City plans to construct sewer on property of Balt. & Ohio R. R., on Furnace Way, involv'g 9,970 ft. 9-20 in. terra cotta pipe. Est. cost abt. $13,000. I. C. Palmer City Co. Bldg. Engr.

Pa., Pittsburgh—Council passed ordinance to rebuild old and build new 9, 12 and 15 in. vitr. sewers in Methy, Jackson and Wyandotte Sts., Parody Way and Soho Playgrounds. Abt. $30,000. N. S. Sprague, City Engr.

S. D., Sioux Falls—Bd. of Comnrs. passed resolution to build lateral sewer on 3rd street betw. Weber-Neswith avenues. Walter C. Leyse, City Aud.; plans with City Engr. Sioux Falls.

Tenn., Nashville—City having estimates prepared for extending storm and lateral sewerage systems. W. W. Southgate, City Engr.

Tex., Houston—City will have plans prepared by City Engr. for sewer on Beauchamp and Pecore streets.

Va., Newport News—War Dept., Washington, D. C., contemplates constructing sewerage disposal plant, including septic tank, etc., at Camp Alexander at cost of $20,000.

Wash., Everett—City Comnrs. have instructed city engr. to prepare plans and with City Atty. to draw up Ord. creating public improvement district for bldg. trunk sewer at Delta.

Wis., Antigo—Bids will be opened in April for trunk line sewer, City Engr. Henry Olk, preparing plans. Reinf. conc. 2¼x4¼ ft., branch sewers, vitr. pipe, 30, 24, 15, 12 and 10 inches in diam.

Wis., Kenosha—$50,000 will be available for water main extensions in city during 1919. P. J. Hurtgen, City Engr.

Wis., Kenosha—Council has approved petition for sewers on various streets. 1,800 ft. 12-in. pipe; 400 ft. 8-in. pipe, 1,600 ft. 15-in. pipe. P. J. Hurtgen, City Engr. City will also rebuild Main street sewer, 1,000 ft. approximately, of 18-in. pipe. P. J. Hurtgen, City Engr.

Wis., No. Milwaukee—$100,000 bonds voted by village to rebuild sewers. H. C. Webster, 490 Morse Ave., Milwaukee, Engr.

W. Va., Martinsburg—City contemplates constr. of sewer system and disposal plant. H. G. Tonkin, Mayor.

WATER SUPPLY AND PURIFICATION

Ala., Union Springs—City voted $10,000 bonds to improve water wks. sys.

Ariz., Prescott—City contemplates water works impvts., incluing storage & distributing reservoir, canal, headgate and supply pipe line. Est. cost $300,000. H. Phillips, Consit. Engr., Internal Bldg., St. Louis, Mo.

Cal., Glendale—Engr. H. B. Lynch, 716 Central Bldg., Los Angeles, retained by city trustees to prepare plans & specfs. for extensions & impvts. to municipal water system and for a power plant; large storage reservoir, settling basin, pumping plant, wells, etc., will be constructed; also a trunk line connect'g pumping plant with reservoir & reservoir with main on Glendale Ave. Est. cost of all the impvts., including electric generating plant $180,000, which will require bond issue.

Fla., Dayton—City contemplates voting on $200,000 bonds to extend water and sewer systems.

Fla., Winter Garden—City plans to vote on from $30,000 to $35,000 bonds to constr. complete water supply system, consist'g. of elevated steel tank with capy. of 50,000 gals., oil pumping engines, brk. pumping station and 16,000-ft. 2-8 in. c. i. pipe. W. Ginn. Sanford, Engr.

Ga., Atlanta—City has voted $500,000 for water works and $300,000 for electric generating plant. H. L. Collier, Chf. of Constr.

Ind., Marion—Bd. of Wks. will take up plans as soon as received from Chicago Engrs., for remodeling & reconstruct'g city water system. T. E. Petrie, City Engr.

Ind., Marion—Petition filed with Bd. of Water Works for extension of water mains on Wabash avenue, from point at Wabash Ave. and Mulberry St. to intersect. of Wabash Ave. and Wood St.

Ky., Newport—City considering improvements to water works to include additional valves and hydrants, 10-in. mains to connect Newport and Covington, Ky., water systems; also additional mains.

La., Marksville—Town has voted in favor of issuing bonds to amt. of $35,000 for purpose of constructing, equipping & maintaining system of water works.

Md., Baltimore—Walter E. Lee, Engr. Water Dept., has submitted report outlining plans for supplying water to Gardenville, Overlea, Eutaw Heights, Belgravia and Raspeburg sections of new annex., proposed until permanent reservoir can be constructed, to force water into distribution mains by electrically driven centrifugal booster pump of 1,000,000 gals. daily capy., to be installed on Belair Ave. no. of Erdman Ave.; plans to supply Westport, Mt. Winans and other sections will involve mainly extension and enlargement of existing mains.

Md., Frederick—City considering installation of water meters; est. cost $30,000. E. C. Crum, City Engr.

Md., Hyattsville, Montgomery County, Md.—Washington Suburban Sanitary Dist. (Robt. B. Morse, Chf. Engr., Hyattsville) contemplates water and sewer supply improvements. Bonds issued for preliminary engrg. work. Water suppy constr. to amt. of $500,000 may be done this year. Total cost for both systems, necessary for that section of city now built up, will be $2,500,000 to $3,000,000; existing systems to be incorporated with general systems.

Minn., Duluth—D. A. Reed, Mgr. Water & Light Dept., in annual report suggests following work, listed in order of importance under present conditions to be done as soon as funds, prices and material permit: Reinfoc. conc. cover for middle system reservoir; lowering 36-in. First St. distributing main to bottom of the ravine where it crosses Tischer's Creek; a 200,000 gal. cistern for New Duluth plant; new pumphouse and electric pump for orphanage system; reconstr. of Endion reservoir; new 20,000,000 gal. pump for Lakewood pumping station; high pressure gas main for Morgan Park and central department bldg.

Mo., Carrollton—Water, Light & Transit Co. considering installing modern water filtering system and make other impvts. to plant. S. J. Jones, Carroll Exch. Bank Bldg., Pres.

Mo., Kans. City—City having plans prepared for erection of pumping station. W. G. Goodwin Engr., Kans. City.

Mo., St. Louis—City having preliminary plans prepared for addition to water works on Missouri River near Creve Coeur Lake. E. A. Wall, Water Comnr., 312 City Hall, St. Louis.

Mo., St. Louis—City will expend $325,000 for concrete covers for filter. basins: one at Baden high-service station ($130,000); two at Bissell's Pt. Station. Total cost for the two $220,000.

Mont., Baker—City having preliminary plans & surveys made by Burns and Mc-

Donnell, Engrs., 400 Interstate Bldg., Kans. City, Mo., for improving water works and sewerage systems.

N. J., Bound Brook—Elizabethtown Water Co., 68 Broad St., Elizabeth, having plans prepared by M. Sherrerd, Archt., 62 Broad St., Elizabeth, for pumping station and filter house near Milltown here.

N. J., Newark—$500,000 bonds solds for water supply system in Wanaqua River watershed and $300,000 bonds for extending water supply system in Pequannock River watershed. M. R. Sherrerd, City Engr.

N. Y., Oswego—City voted $150,000 to be added to existing appropriation of $345,000 to develop water power. W. A. McCaffrey, Supt. Water Wks.

N. Y., Watertown—City will petition legislature, Albany, to make surveys & prepare plans for bldg. impound'g. dams on Black & Beaver rivers for water storage.

O., St. Bernard—Henry Nunist, 1113 Traction Bldg., Engr. of village, has plans for repairs to water works system to be advertised as soon as bonds now being offered for sale are disposed of. Repairs to bldg. & machinery will cost abt. $15,000.

O., Springfield—Supt. Geo. Cotter, Water Wks. Dept., has filed annual report and recommends a pitometer survey to ascertain underground leakage; installation of storage supply at station for peak loads; purchase and installation of 2 boilers or old boilers be rebuilt; also installation of coal-handling facilities.

Okla., Chicago—City considering holding election to vote on $75,000 bonds for improving water works system.

Okla., Bixby—$85,000 bonds voted for constructing water and sewerage system.

Okla., Perry—City plans expendt. of $100,000 to improve water works and electric light plant.

Okla., Pauls Valley—City having plans prepared to extend water and sewer system. W. E. Moore, Engr., 1006 Campbell Bldg., Okla. City, Okla. Est. cost $25,000.

Pa., Kutztown—Boro voted $15,000 bonds to improve water works plant.

S. D., Mitchell—Plans completed and will soon advertise for bids for water works system; 3 different types pumps being considered; triple expansion steam driven pumping engine; motor-driven centrif. pumps with general units and motor-driven centrif. pumps to be operated with purchased power. S. H. Smith, City Engr.; Burns & McDonnel, Consit. Engrs.

Tenn., Ripley—City will vote abt. May 1 on $150,000 bonds for constr. of water, light and sewerage systems. Calvin Conner, Mayor.

Wyo., Casper—Council will authorize bond issue in sum of $320,000 for sewer construction and extension of water mains.

Wis., Wausau—City contemplates expendit. of $100,000 for water works system.

BRIDGES AND BUILDINGS

Ala., Huntsville—Madison Co. Comnrs. contemplate expendit. of $60,000 for brdg. and road constr. betw. Huntsville and Owens; conc. brdgs. and 8 miles of road.

Ariz., Jerome—County Supvrs. have appropriated $20,000 for constr. of Verde Bridge; state has appropriated an equal amount and plans have been prepared by state engineer.

Cal., Los Angeles—City Engineer Hansen reports that it will cost about $2,8000 to construct bridge across Los Angeles river at Saugus Ave. City council will consider the matter.

Ga., Fitzgerald—Ben Hill Co. Bd. of Rds. & Revenues having plans prepared to construct bridge across Ocmulgee river near Fitzgerald. W. M. Garbut, Chmn.

Ga., Thomasville—Thomas Co. Commrs. considering bldg. brdg. over Ochlocknee River on Dixie Hwy. Est. cost $60,000, of which Govt. will contribute $30,000.

Ia., Atlantic—Co. Engr. Williams reports that 2 bridges and 13 culverts will be built during this year. E. Kringel, Aud.

Ind., Ft. Wayne—Park Board will consider plans for bridge across St. Marys river in Swinney Park. Appropriation of $15,000 for erection of old State street bridge ratified by Comnrs.

Ind., Ft. Wayne—Appropriation giving $4,000 to brdg. acct. adopted by council for impvt. of Main street bridge.

Ind., Terre Haute—Plans & specifs. for 4 cement brdgs. approved by County Comnrs. Black brdg., Sugar Crk. Twp., est. cost $2,837; Miller brdg., Pierson Twp., $8,460; Jackson Hill brdg., Fayette Twp., $4,909; Welch brdg., Linton Twp., $2,578.

Ind., Vincennes—Knox & Daviess County Comnrs. will hold joint meeting to discuss constr. of bridge across White River at Elnora.

Ky., Covington—Jno. E. Shepard, City Solicitor, reports that the Railroad Administration will erect a new bridge across Licking River at Covington, to replace old Chesapeake and Ohio R. R. structure. Est. cost $388,500; it is also reported that the other brdgs. betw. Covington and Silver Grove are to be reconstructed to provide for heavy travel betw. these points.

Md., Cumberland—Comnrs. Alleghany Co., plan to build 2 steel span brdgs. conc. sub-structure on 2 road crossings over Town Crk. Abt. $12,000. D. P. La Fevre, 3rd National Bank Bldg., Engr.

Minn., Caledonia—Plans are made for constr. of 5 bridges, spec. by State Hwy. Comn.. Guardian Life Bldg., St. Paul. Aso. Engr. C. D. Gonzett, local.

Minn., Detroit—Becker county considering constr. 3 bridges; 20 ft. spans. J. A. Narum, Aud.

Minn., Long Prairie—Todd county considering bldg 4 bridges during 1919, reinf. conc. and struc. steel; one to have 70-ft. span. $15,000. E. M. Berg, Co. Aud.

Minn., Wabasha—Plans prepared for brdgs. in Gillford, W. Albany and Greenfield Twps. Geo. J. Ginthner, Aud. Wabasha Co.

Mo., St. Louis—City will build reinf. conc. bridge on Southwest Ave.; cost $33,000; also plan to build bridge on 14th street. $30,000; invites bids. L. R. Bowen City Engr.

Mont., Fort Benton—Choteau county has approved petition to construct county bridge across Teton river and has directed County Surv. to prepare plans. Cost not to exceed $10,000. Harry C. Donaldson, Co. Clerk.

N. C., Manchester—Cumberland County Comnrs., Fayetteville, N. C., will construct conc. bridge over Little River to replace burned structure.

N. J., Elizabeth—Plans being made by Bd. Freeholders to construct bridge over Green Brook, betw. Plainfield & N. Plainfield. Geo. G. Teller, Direct.

N. J., Newark—Essex Co., (Newark) and Hudson Co., (Jersey City) plan joint appropriation for preliminary survey, estimates, etc., for bldg. bridge over Newark Bay betw. here and Bayonne. F. P. Reimer, Co. Engr. former county, and J. J. Wasser, Engr. of latter.

N. J., Newark—Essex county (Newark) and Morris Co. (Morristown) having plans prepared rebldg. Columbus and Hanover Cook bridges over Passaic River. About $70,000. F. P. Reimer, Court House, Newark Co., Engr.

N. Y., Watertown—Preparations taken by Pub. Wks. Bd., for constr. of new conc. arch bridge to replace old steel struc. on Factory street; action also started to make possible new bridge at Diamond Isl. Resolution adopted requesting Common Council to submit bond propositions to voters at special elec., in amounts of $60,000 for Factory St., and $125,000 for Diamond Island bridges.

Ohio, Dayton—Montgomery county is going ahead this spring with constr. of bridges valued at $1,500,000 to replace those destroyed by flood.

Ohio, Fort Clinton—In addition to bldg. road 1.6 miles long in Salem Twp., Ottawa county will also construct 2 bridges at cost of about $8,000.

O., Youngstown—Important conference held in regard to proposed Liberty St. viaduct, with consulting engineers of the Watson Engrg. Co., Cleveland. Plans for short bridge abandoned; other plans progressing for struct. that will reach from High street to point on hill in Weathersfield twp. west of Girard.

Ore., Wood River—Co. Engr. Crubishank engaged in making survey for brdg. across Rail Crk. in East Barrett district; 250 ft. long, unless county decides to fill in part of the gorge with earth approaches. and for a brdg. 150 ft. long across Indian Crk. on Brookside Drive.

Pa., Pittsburgh—Alleghany County will expend $10,000,000 for bridge work. Four new bridges will be erected as soon as estimates can be completed and work begun on them; four others must be raised. National House of Rep. passed 3 bills authorizing bldg. of 3 bridges in Alleghany Co., another bill will come up for consideration in immediate future. The two structures for which plans are now being drafted and upon which work will begin this summer are the rebldg. of the old 16th street bridge and a new struct., will be constructed across the Alleghany River at 40th St., crossing into Millvale. 16th St. bridge will cost approx. $700,000; bridge at 40th St. abt. $1,000,000; another bridge will be built on Monongahela river—Glassport to Wilson, at cost of about $600,000; fourth bridge is at McKees Rocks on Ohio river crossing from mound at that borough to point near location of Western Penitentiary. Approx. cost $2,000,000. If Sec. Baker cannot be prevailed on to withdraw his orders providing for raising all brdgs. on Allegheny River, 4 other bridges will have to be raised—6th, 7th, 9th and 30th street bridges, and this will cost approx. $1,000,000. J. G. Chalfant.

S. D., Watertown—Construction of 5 reinf. conc. bridges contemplated; 16 to 24 ft. span. Wm. N. Olson, Co. Aud., Coddington Co.

Wn., Seattle—Election to be held this month to vote on bond issue for purpose of bldg. bridge across West Waterway on Spokane street. Proposed structure will cost abt. $900,000.

W. Va., Parkersburg—Comnrs. Wood county (Parkersburg) and Pleasant Co., (St. Marys) plan to construct 65-ft. conc. bridges over Bull Creek betw. 2 counties. Cost betw. $20,000 and $40,000. J. J. Alexander, Parkersburg, engineer.

Wis., Madison—Following bridges will be built: Dodge Co., Leroy Twp.; Gindt bridge; 10-ft reinf. conc., 20-ft. rdway, masonry abutmts. E. T. Klug, Juneau Co. Hwy. Comnr; Lafayette county, Benton Twn.; Meekers brdg., 50-ft. riveted low truss span, 20-ft. rdway. conc. abutms. Geo. Priestly, Darlington, Co. Hwy Comr.; Wood Co., village of Nekoosa; "B" street brdg., 10-ft reinf. conc. span, 20-ft. rdway conc. abutms. L. Amundson, Grand Rapids, Co. Hwy. Comnr.; Dane Co., Cottage Grove Twp.; Mickelson brdg., 16-ft reinf. conc. span, 24-ft. rdway, conc. abutms. Plans with Wisc. Hwy Comn., F. M. Lipke, Courthouse, Madison Co., Co. Hwy. Comr. Douglas Co., Superior Twp.; Little Pokegama brdg., 20-ft reinf. conc. span, 20-ft. rdway, conc. abutm. C. J. Morriset, East End, Superior Co. Hwy. Comnr.

Wis., Reedsbury—City contemplates bldg. 2 span, reinf. conc. bridge. Abt. $25,000. H. E. French, City Hall, Baraboo, Engr.

Wis., Sheboygan—Sheboygan county. Plans being drawn for 5 concrete brdgs. betw. Sheboygan Falls and Plymouth, Wis. Harry Donahue, Sheboygan.

Wis., Menasha—E. B. Parsons, Consult. Engr., has been selected by council of Menasha to design and superintend the constr. of a concrete bridge on Washington street over the Fox River. Bridge will consist of several arches; length being 430 ft. and abt. 60 ft. in width.

Wis., Viroqua—Vernon county: Readstown bridge will be built over Kickapoo River, one 60x20 ft. riveted truss span; four 30x24 ft. reinf. conc. spans and one 30-ft conc. span with varying roadway. Alex Ristow, Co. Hwy. Comnr.

Wis., Shawano—Shawano county will construct 25 bridges, reinf. conc. Abt. $1,000 each. N. F. Meyers, Hwy. Comnr.

W. Va., Pineville—Bids will be asked abt. July 1 by County Comnrs. for construct'g 3 concrete bridges in Barkers Creek, 50 ft. long, 16 ft. wide over all, etc. Est. cost of each $2,500. A. B. Shannon, Engr., Pineville.

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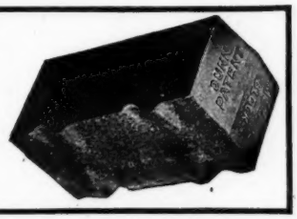

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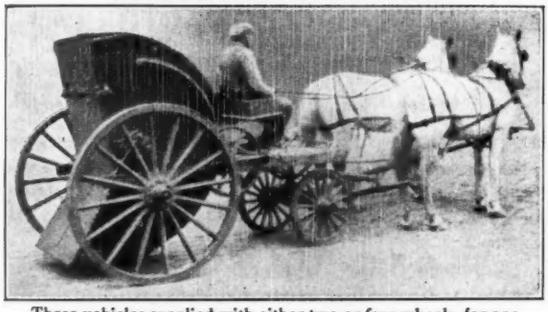

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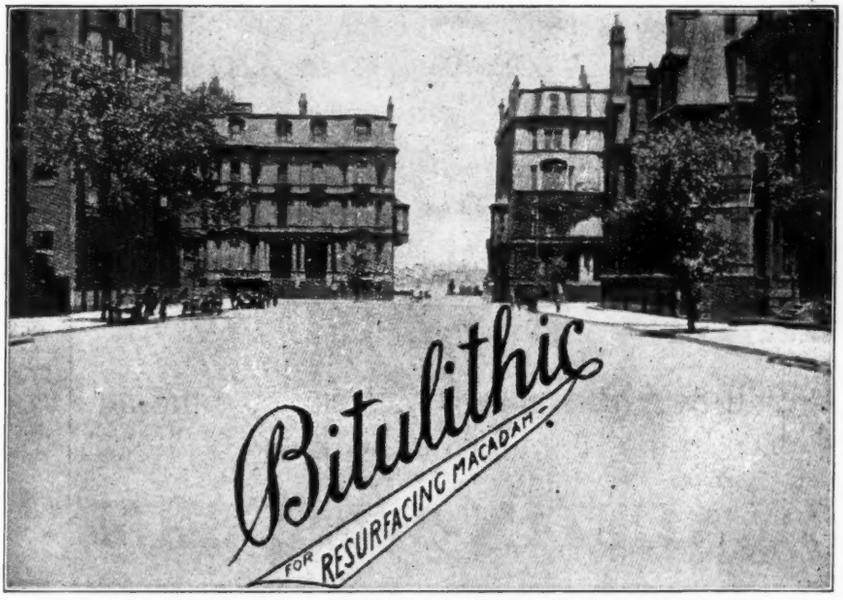

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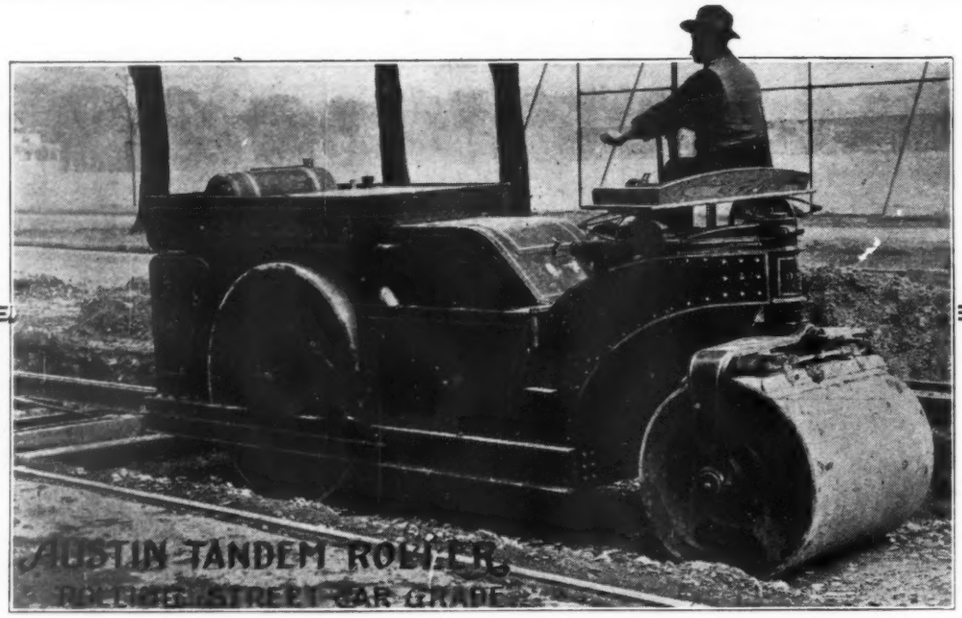

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